

SAMSUNG WASHER WITH UPDATES



Brought to you by:

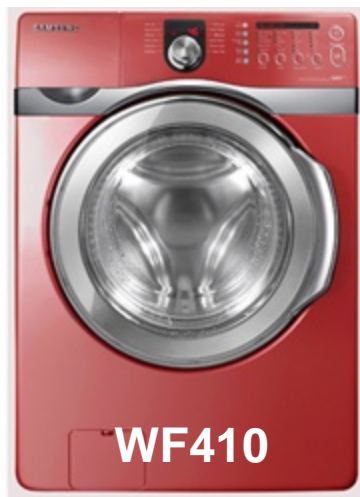
MSA
Marcone Servicers Association

Washers and Dryers for cleaner living



WF520

1 Version



WF410

2 Versions



WF350

2 Versions



WF330

2 Versions



WF220

1 Version



WF210

2 Versions

2010 Models Above



WF409

2 Versions



WF448

5 Versions



WF419

4 Versions



WF328

3 Versions



WF219

2 Versions



WF218

2 Versions



WF209

2 Versions

Questions or comments? Please e-mail richard.kuemin@marcone.com



Critical Parts Look-up Information

- **Always** look for a “Version Number” on all products, if you are looking up parts, ask tech to verify “Version”.
- **Always** get the Serial Number on all products. There are “Running Changes” that have “Bulletins” referring to part number changes at a production Serial Number. If you are looking up parts, ask tech to verify “Serial Number”.
- Laundry – Software Code could be important.
- Any Doubt Call GPCA
- Refurbished Products have no Serial or Version #s

SERVICE BULLETIN

WF209ANW/XAA, WF218ANB/XAA , WF218ANW/XAA
WF219ANB/XAA , WF219ANW/XAA

- **SYMPTOM:** When the cold water temperature is low, especially in winter months, the washer has a more difficult time balancing, creating excessive vibration. The washer may extend the spin time or finish the last spin with clothes remaining wet.

- **REPAIR:** First verify the current version of software in the unit. This can be done by pressing the SPIN, SOIL LEVEL and POWER buttons simultaneously with the power off. The software version will be displayed on the front panel display followed by 1 e. Refer to the version table listed below to determine if a new main PCB is required.

SERVICE BULLETIN

WF209ANW/XAA, WF218ANB/XAA , WF218ANW/XAA

WF219ANB/XAA , WF219ANW/XAA

Model	Before	After
	Software Version #	Software Version #
WF209***	b90b (Upgrade required)	b90c (No upgrade required)
WF218***	6n26 (Upgrade required)	6n27 (No upgrade required)
WF219***		
WF229***		

If an upgrade is required refer to the service manual for disassembly / reassembly procedures.

Model	Part Number	Description
WF209** series	DC92-00288C	Main PCB
WF218**	DC92-00288A	Main PCB
WF219**	DC92-00288A	Main PCB
WF220**	DC92-00288A	Main PCB

Questions or comments? Please e-mail richard.kuemin@marcone.com

The **Tech** is expected to meet higher standards

□ What advice would you give to a technician who questions the customer's intelligence by saying something like:

- **“We’ve had nothing but trouble with this model.”**
- **“I see this problem all the time.”**
- **“Why did you buy this Brand Samsung product? Brand Z is much better.”**
- **“You should have purchased a simpler machine. This one has too many bells and whistles and doesn’t clean/dry/cook/cool any better than a cheaper one.”**



Laundry Serial Number



Production Year		
R : 2001	T : 2002	W : 2003
X : 2004	Y : 2005	A : 2006 Jan
L : From 02/2006	P : 2007	Q : 2008
S : 2009	Z : 2010	B:2011
C:2012	D:2013	F:2014
G:2015	H:2016	J:2017
K:2018	M:2019	N:2020

6 3 5 5 4 3 C P 1 0 0 1 6 0 A

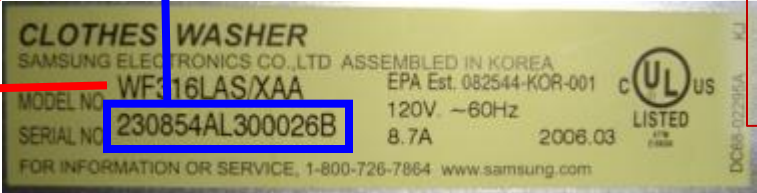
Production Country
Korea 2,3
China A
Thailand D
Mexico G
India Z
USA ???

Production Line

Check Digit

Pro. Month
1~9 : Jan~Sep
A : October
B : November
C : December

Model Name



Reject Reasons:
Missing the "/XAA"
Missing the "Check Digit"

Samsung HA Warranty

- ❑ **ALL Warranties are subject to change, always verify.**
- ❑ 1 Year Parts & Labor Base Warranty, Labor may not apply over 1 year
- Some items may have longer Warranties, Check Owners Manual or 800-SAMSUNG
 - ❑ Refrigerator Sealed System Five Years Parts & Labor
 - ❑ Laundry 2 years on Control Boards, 3 years on Stainless tubs, 10 years on DD washer motors
 - ❑ M/W oven 10 years on Magnetron Tubes
 - ❑ Range 5 years on Glass Cooktop and Radiant Surface Units
 - ❑ D/W 5 years Printed Circuit Board, Racking and Lifetime Stainless Door Liner & Tub for leakage.
- ❑ No Damage Warranty, Consumer or Stock
- ❑ One Year, One Call for Consumer Education
- ❑ Stock Repair, 24 months from date of manufacture
- ❑ Two Stock Repairs allowed under Warranty
- ❑ Questions or comments? Please e-mail richard.kuemin@marcone.com
- ❑ Refurbished Product has no Warranty

Fast Track Troubleshooting

SHIPPING CART

Enter Model Code Here
rfg295

Service Areas

Parts Management

- Parts Research
- Parts Order
- Core Return
- Parts Return
- Parts Accounting

Warranty

Search Result

Model Code: rfg295*

SEARCH

No	Model Code	Service Manual	Training Manual	User Manual	Service Bulletin	Service Tip	Driver	Firmware	Redo Tip	Repair Tip	BOM
1	RFG295AABP/XAA	1	1	1	1	19	0	0	1	0	
									1	0	
									1	0	
									1	0	

Service Tip (Local)

Model Code

Title

- RF265ABPN/XAA,RF265A... Removing Center Mullion Left Side Refriger
- RF26VABBP/XAA,RF26V... Removing Freezer Drawer for Service
- RF26VABBP/XAA,RF26V... Frost In Ice Bucket / French Door Alignmen
- RFG295AABP/XAA,RFG2... Inverter Compressor Test Procedures
- RF26VABBP/XAA,RF26V... Shelf's Loose / Sag When Loaded
- RF265ABPN/XAA,RF265A... Use the model code, and BOM name for all
- RF267ABBP/XAA,RF267A... Removing the display panel on the RF serie
- RFG295AABP/XAA,RFG295A... Fast Track Manual**
- RF26VADBP/XAA,RF26V... Water Comes out of Chute While Dispensin

Service Tip (Local)

back Close

Category: Home Appliances / Refrigerator / Refrigerator

Model Code: RFG295AABP/XAA,RFG295AAPN/XAA,RFG295AARS/XAA,RFG295AAWP/XAA

Title: Fast Track Manual

The attached file continues diagnostic procedures, component verification information, board layouts, schematics and a simplified circuit explanation. The file provides a quick service guide to efficiently service these products.

Added by: JIM SWIFT

Added on: 08/11/2009 17:57:03

E-mail: j.swift@marcane.com

Bulletin:

Mileage: 100 Miles

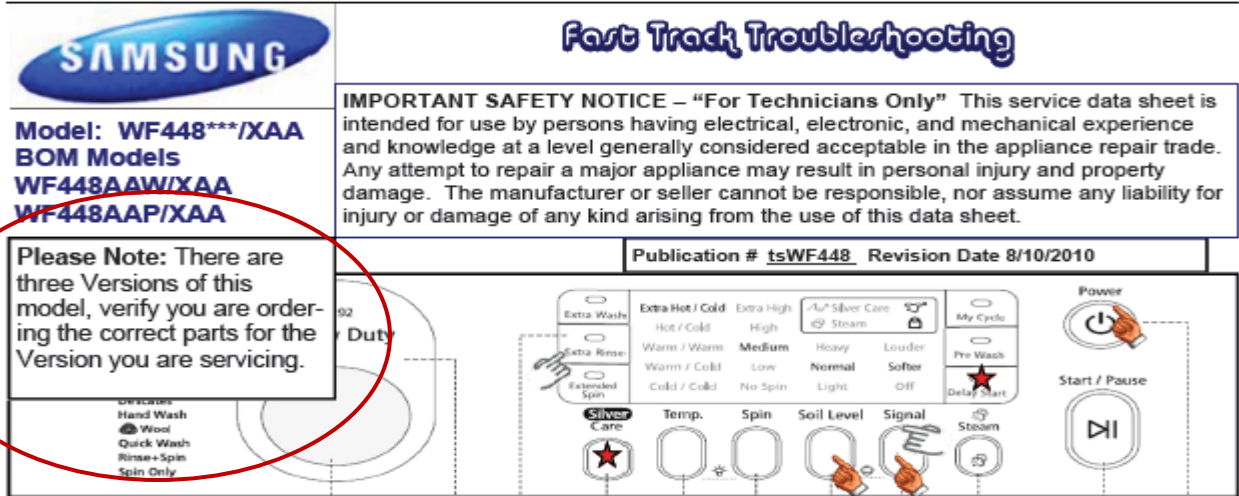
Attach: ☒ Select all

☐ RFG295AA Fast track R1.pdf (1647K)

back Close

Questions or comments? Please e-mail richard.kuemin@marcane.com

Fast Track Manual Example page



Quick Test Mode

Note: This test erases all faults and memory:
 To enter press **Soil, Signal, & Power** simultaneously with the power off.

1. All LED's light up and the washer beeps as it enters the Quick Test Mode.
2. The unit displays the software version for a second then clears the EEPROM.
3. After the displaying the software version, LCD will display Model information. If EEEE is displayed the PCB ass'y is defective.
4. When the version is displayed, turn the Jog-Dial so that the version disappears. Press the following keys to test the various components

Press **Temp Key** to cycle through the Water Valves circuit test (**lock the door first**) in this order: Pre-Wash, Bleach, Cold Main, Hot, & Steam, then off.
 Press **Spin Key** to test Door Lock/Unlock circuit
 Press **Soil Level Key** to test Circulation/Drain Pump.
 Press **Signal Key** to test the Water/Steam Heater.

When either **Test** or **Spin** is displayed on the LCD, press **Start/Pause** key to conduct the motor test.
 In **Test mode**, you can test the clockwise and counter-clockwise movement of the motor. However, the water level must satisfy the heater water level (24300) to enter Test mode.
 In **Spin mode**, you can test the motor at a high rpm.

EEPROM Clear Check

Power off, Press Delay Start, Signal and Power Key at the same time continuously for 10 seconds.
 All memory will be cleared, including Fault Codes
 This should be done when a new Main PCB is installed

Service Mode:

This mode allows more detailed operation tests and troubleshooting, to enter press **Signal & Extra Rinse** simultaneously with the power on.

While in Service Mode the following tests can be performed:

Quick Spin Test = Delay Start & Silver Care: ★ This accelerates the drum motor from 0 to maximum RPM over a few minutes. **Note: Stay with the washer during this test, out of balance detection is bypassed and the door may not lock.** Press the Start/Pause button during the test to hold its spinning speed for 10 minutes before going back to Quick Spin Test Mode.

Cycle Count = Press the Signal button to see how many times the unit was used

Soft Ware # = Press the Soil button to see the software version information

Fast Time Down = Press the Temp button to advance to the next cycle

Fault Code Test = Press the Silver Care button to view the stored fault codes – then turn Jog Dial to view error codes (Push Start/Pause while the code is displayed to view the number of cycles since the error occurred)

Peripheral (Main PCB) input Tests

1. **Select Extra Wash.** Then turn the Jog-Dial so that the Extra Rinse LED is turned on. Next, press the Start/Pause Key. The Water Temperature will be displayed in Fahrenheit.
2. **Select Extra Wash.** Then turn the Jog-Dial so that the Extra Spin LED is turned on. Next, press the Start/Pause Key. The door status will be displayed (OP if open, CL if closed).
3. **Select Extra Wash.** Then turn the Jog-Dial so that the Delay Start LED is turned on. Next, press the Start/Pause Key. The door lock Switch status will be displayed (UL if unlocked, Lo if locked).
4. **Select Extra Wash.** Then turn the Jog-Dial so that the Pre Wash LED is turned on. Next, press the Start/Pause Key. The Water Frequency will be displayed.
5. **Select Extra Wash.** Then turn the Jog-Dial so that **My Cycle** LED is turned on. Next, press the Start/Pause Key. The AG Kit status will be displayed after 3 seconds. ("N E" if the AG kit is abnormal. "—" if the AG Kit is working properly)

Questions or comments? Please email techbook@marcone.com



SAMSUNG

**Look for
Version #
anytime parts
or service
information
are needed for
a product.**



Refurbished Product
will not have the
Version Numbers

WF328*
Version 02 has
front pump**

CLOTHES WASHER
SAMSUNG ELECTRONICS CO., LTD.
MODEL NO. WF328AAW/XAA 02
SERIAL NO. W01F54AS504432K

Questions or comments? Please e-mail richard.kuemin@marcone.com

Samsung Laundry **NEW:** WF520 5.0 cu. ft. **VRT PLUS™ PowerFoam™ Steam**



Samsung's new PowerFoam technology creates a deep cleaning foam that gets your clothes clean! richard.kuamini@mptone.com
Questions or comments? Please email richard.kuamini@mptone.com
"Based on tests using AHAM HLW-I-2007 detergent standards.)"



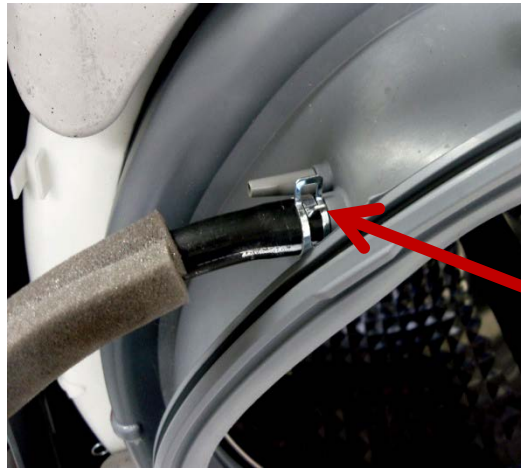
POWER FOAM FUNCTION (WF520)

The Power Foam Technology generates foam, or suds which allows the detergent to evenly penetrate the fabrics faster. The basic technology is the detergent is dissolved with air and water before the normal wash cycle starts.

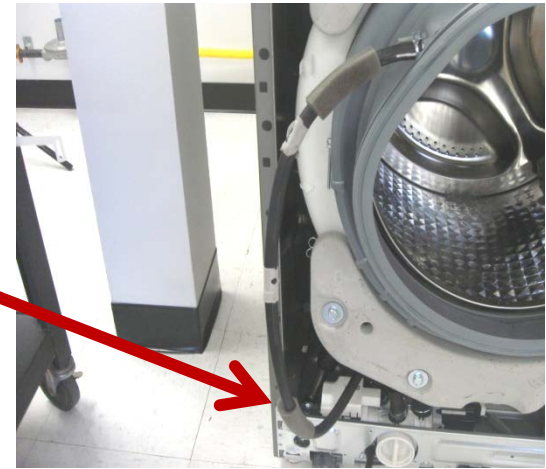
- 1)The normal wash was selected. (Time 56 minutes)**
- 2)The start/pause button was then pressed to activate the wash cycle.**
- 3)The drain pump was then activated.**
- 4)Once the wash cycle reached 52 minutes (remaining time, which means 4 minutes into the cycle) the Power Foam function was then activated.**
- 5)The Power Foam function lasted for a total of 5 minutes.**



Air is being drawn in from this nozzle.



The air passes through this hose to the bottom of the outer drum.



At this point the air mixes with the detergent and water that is in the outer tub.



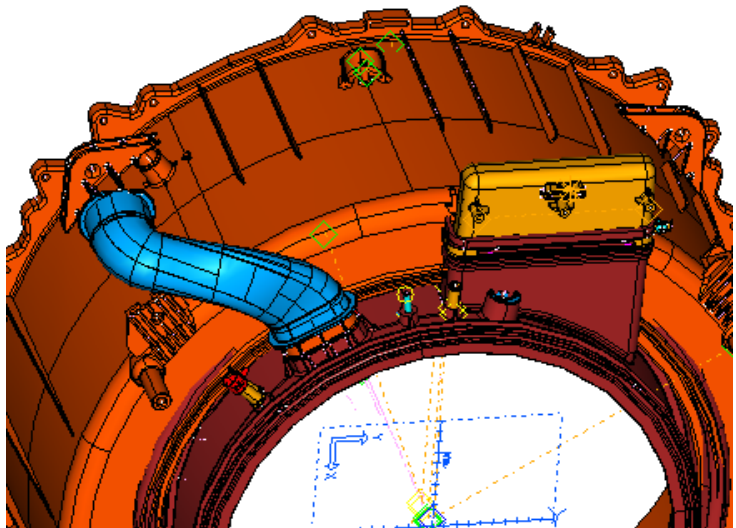
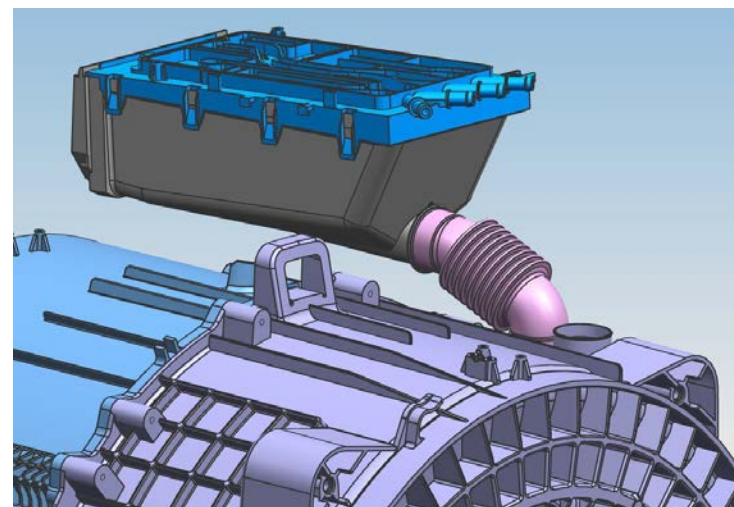
Air is drawn in from the inner tub and re-circulated down into the bottom of the outer tub. Once the air enters the bottom of the outer tub it then mixes with the water and detergent that is at the bottom of the tub which creates the foam.

Recirculation Pump is our new “Bubble” creating device.

Questions or comments? Please e-mail richard.kuemin@marcone.com

Changed Part List WF520

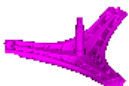

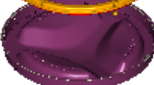
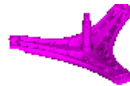


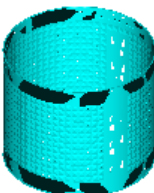







Hose Drawer Tub

Basic (Purple)	Grace
	
<ul style="list-style-type: none"> • Water Supply : Front 	<ul style="list-style-type: none"> • Water Supply : Side (Tub Front)

Questions or comments? Please e-mail richard.kuemin@marcone.com

Changed Part List WF520

ASSY-Spin Drum

Basic (Purple)		Grace
  	<div><div>1</div><div>2</div><div>3</div></div>	  
	<div><div>4</div></div>	
	<div><div>5</div></div>	
 	<div><div>6</div><div>7</div></div>	 

	품 명	비고
1	Ass'y-F/Shaft (Ring-OG 적용)	Same
2	Ass'y-Balance (후면)	
3	Drum-Back	
4	Drum-Wrapper	Capacity
5	Drum-Lifter	
6	Drum-Front	Same
7	Ass'y-Balance (전면)	

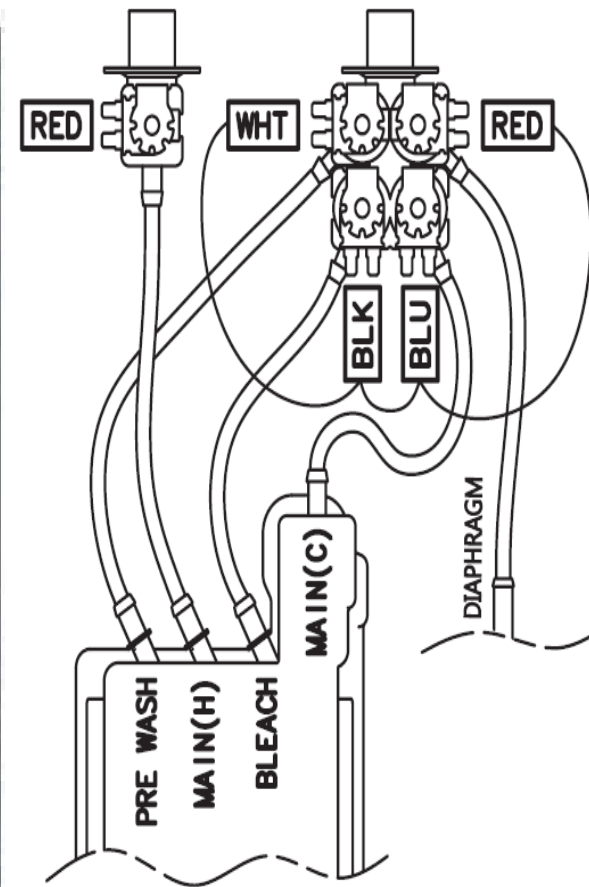
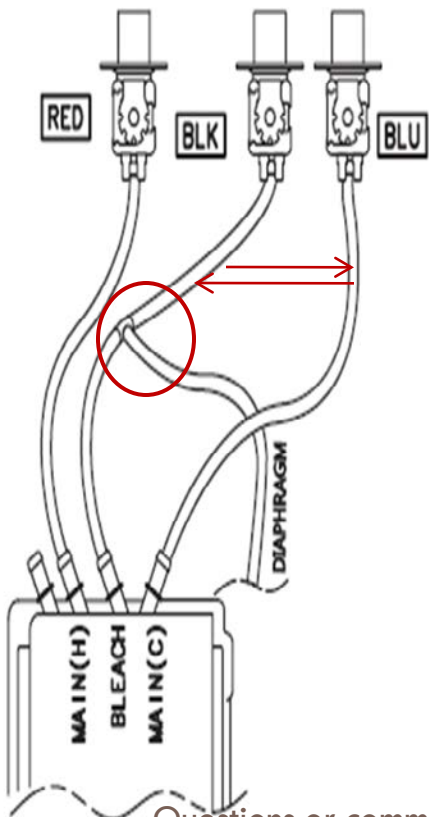
Questions or comments? Please e-mail richard.kuemin@marcone.com

Window/Diaphragm Cleaning

Original Design
WF210
WF220

Updated Design

WF330
WF350
WF410



Questions or comments? Please e-mail richard.kuemin@marcone.com



Temperatures

Location Considerations

Do not install your washer in areas where water may freeze, since your washer will always maintain some water in its water valve, pump, and hose areas. This can cause damage the belts, the pump, hoses and other components. **Operating temperature should be above 60°F on all Models.**



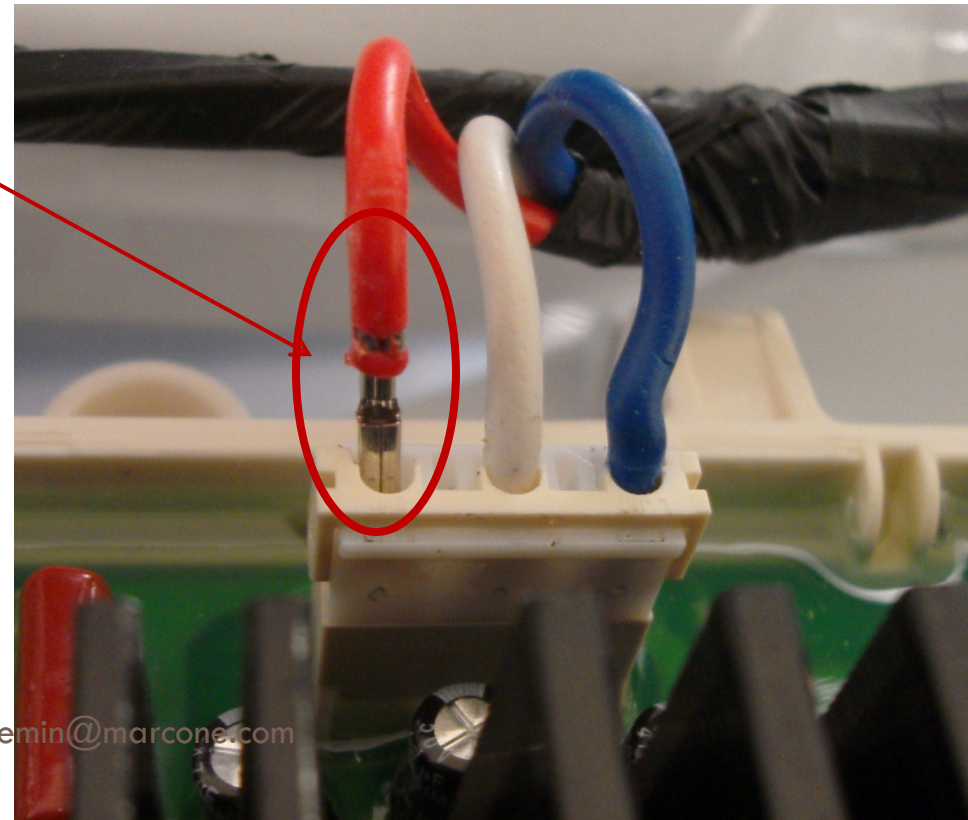
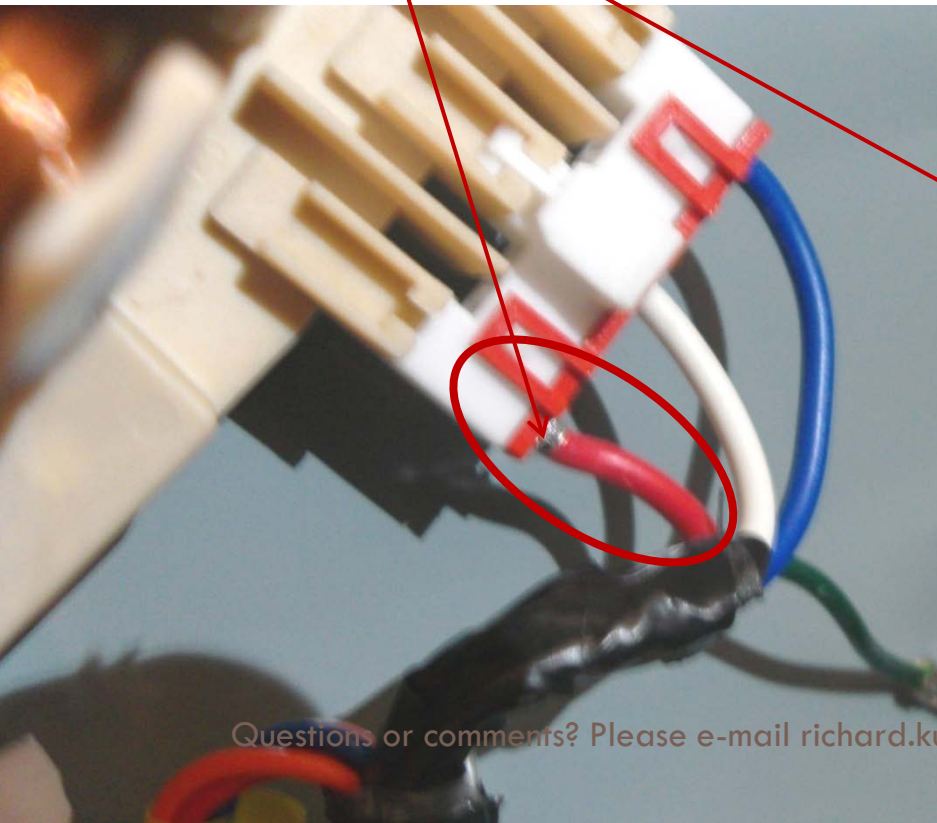
Extended Cycle Time

Sometimes No Spin

- What causes extended time Spin/Wash issue?
 - ▣ Out of Balance – 45 min. or more, at Spin Cycle
 - ▣ Over Sudsing - 1 hour or more, at Spin Cycle
 - ▣ Poor Drain - up to 15 minutes for each drain cycle
 - ▣ Slow Fill - 5-10 minutes each fill
- What Monitors “Out of Balance”? Over Sudsing?
 - ▣ PCB / Motor

Wet/Damp clothes,
stopping in spin or
heavy wash load,
noise from motor.
The wire can be locked
back in the connector

3E fault – all models



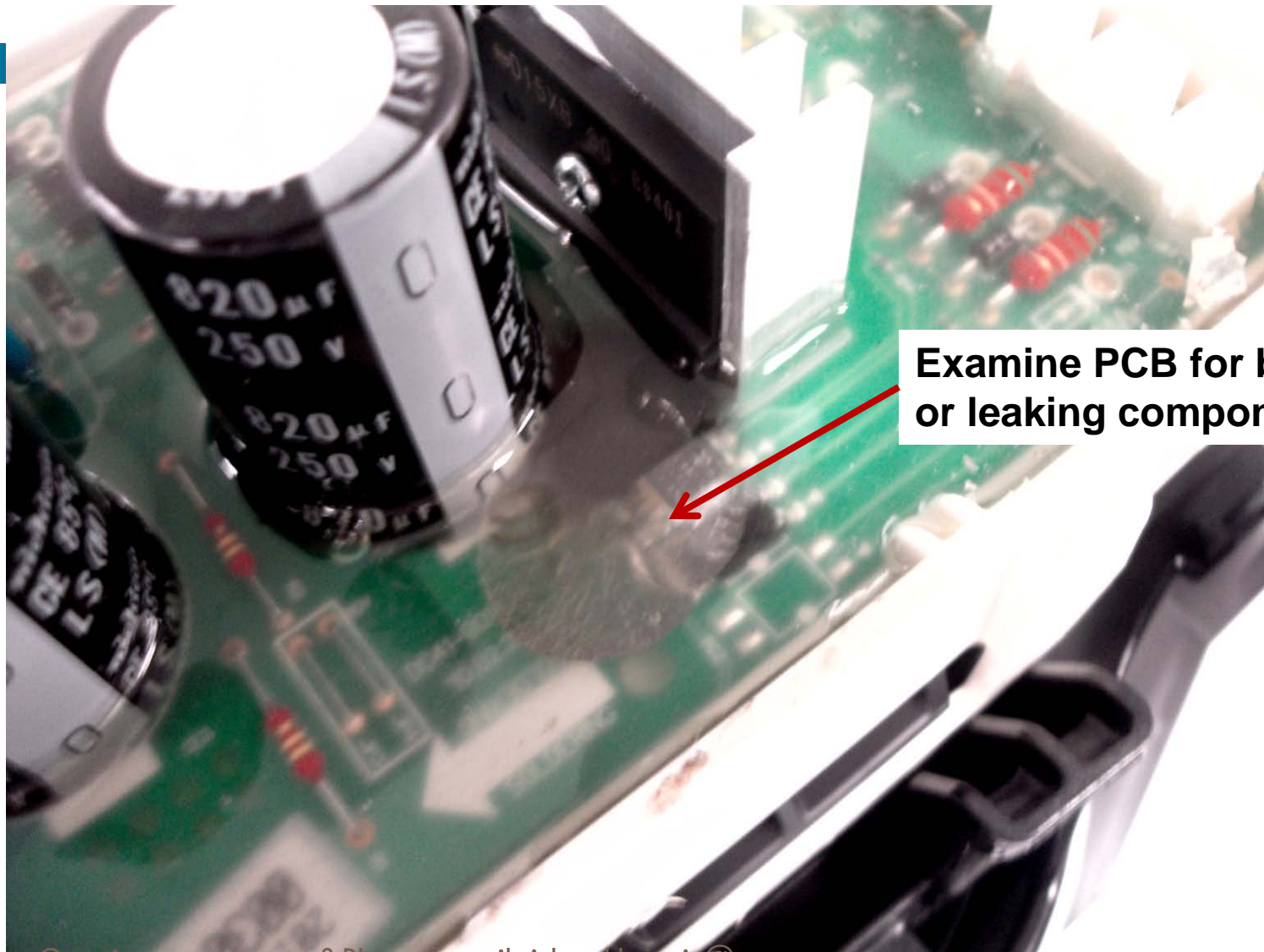
bE Error Code

WF210, WF220 “be” Error Code



This error code indicates a “Motor drive, or Hall sensor error”. WF210 and WF220 “bE” error code units. All of these issues, to date, were corrected by replacing the Main PCB.

2E Faults (Failed Electrolytic Capacitor)

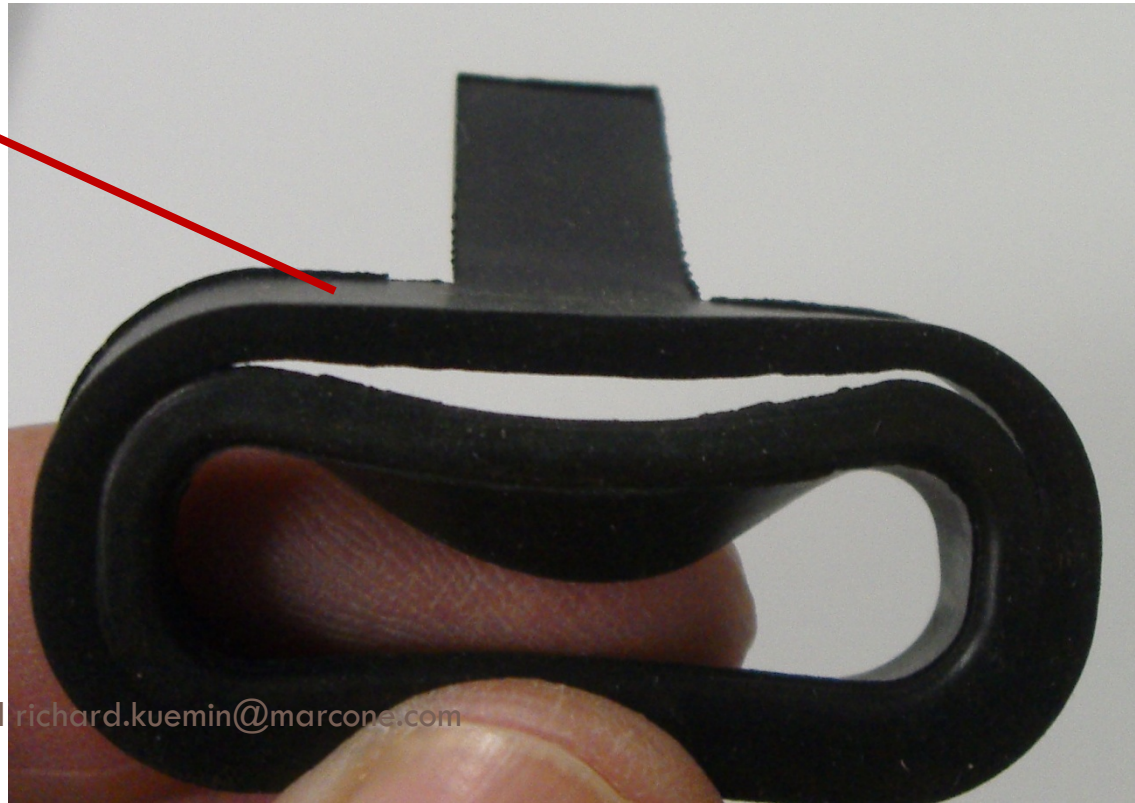
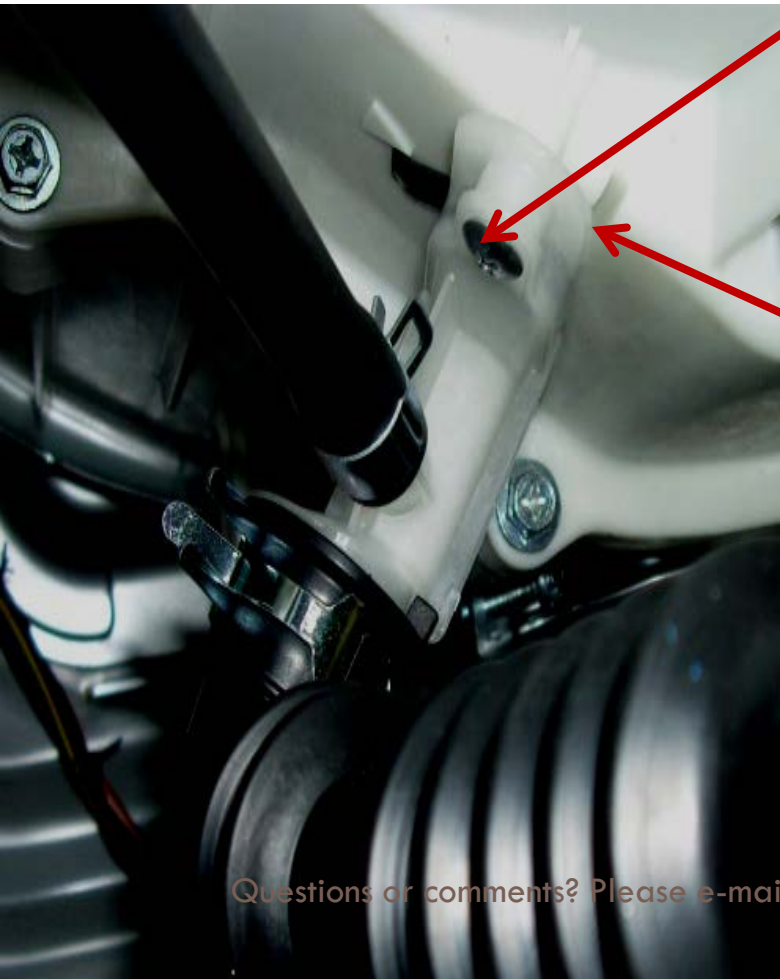


Examine PCB for burned or leaking components.

Questions or comments? Please e-mail richard.kuemin@marcone.com

WF520 Leak under washer

Don't over tighten



Questions or comments? Please e-mail richard.kuemin@marcone.com

FAILED DAMPER SHOCK

1 Stage Damper Shock



DC66-00470B DAMPER-SHOCK; TUB-BACK ONLY 1 Stage Single VRT

2 Stage Damper Shock



DC66-00470A DAMPER-SHOCK; TUB-FRONT & BACK 2 Stage Double VRT

The symptoms that could occur from a failed Damper shock.

- **Noise**
- **Vibration**
- **Intermittent No Spin**
- **Does not achieve maximum RPMs**
- **Clothes wet after spin cycle or sometimes very damp, but not dry**

GOOD



FAILED



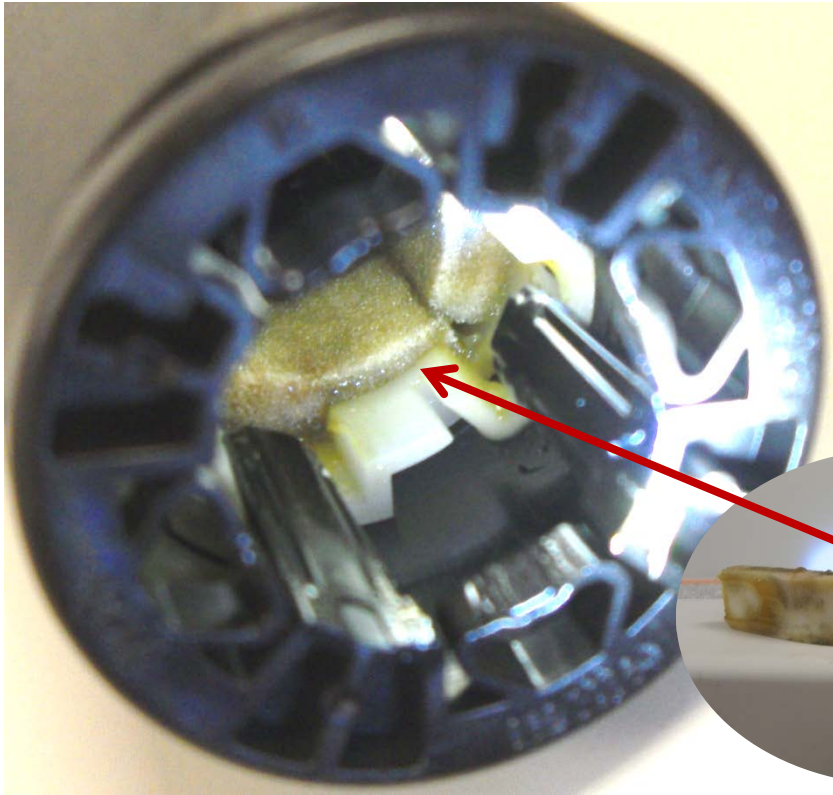
There are no visual indication between a failed, or good damper shock. You need to physically grab the shock and move it to determine if it's failed or not.

Grab the damper shock and move it back and forth. A good shock will have very little wobble, or play in it. A failed shock will have a wobble to it.

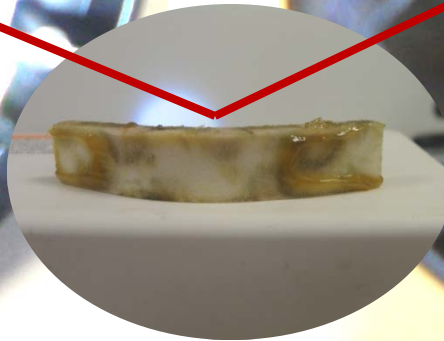
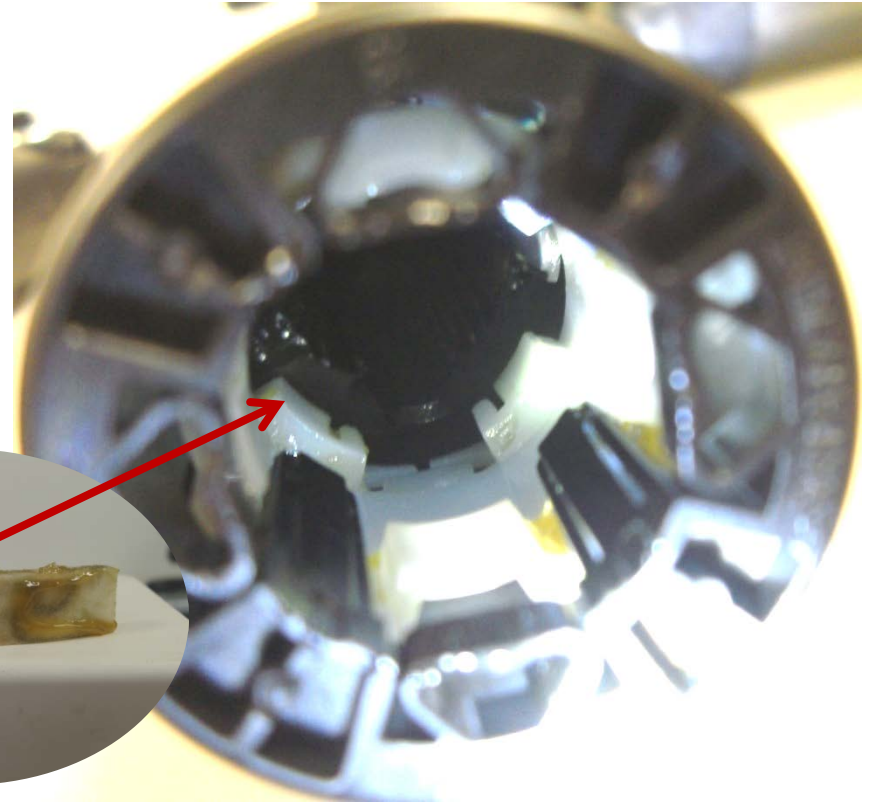


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GOOD



FAILED



The wobble is caused because the foam, which has the lubricant, has become dislodged.

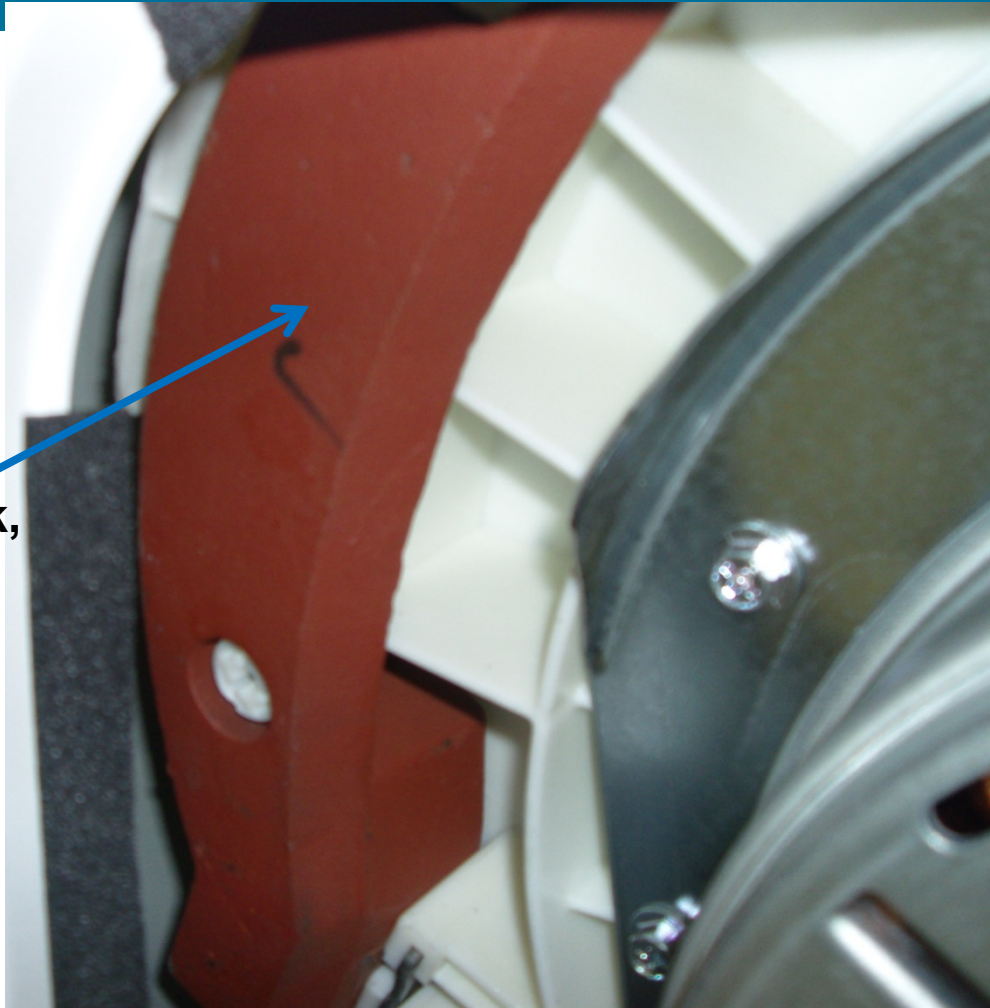
Questions or comments? Please e-mail richard.kuemin@marcone.com

Single VRT WF330, 350, 407, 409, 410, 419

DC66-00470B DAMPER-SHOCK; TUB-BACK 1 stage Single VRT



VRT Models with weight on the back, are Single VRT



What if we have trouble with excess vibration on certain floors with these models?



Questions or comments? Please email richard.kusmin@marcone.com

DC66-00470A DAMPER-SHOCK; TUB-FRONT 2 stage Single VRT

WF520 VRT + Dual MEMs



Questions or comments? Please e-mail richard.kuemin@marlone.com

Out of Balance

- When the unbalance time exceeds 15 minutes during the spin cycle, it executes the untying operation to balance the load. It will tumble at 50 RPM and add water and pump out twice, then generate an error (dc) the third time. This will last about 30 minutes.
- Temperatures under 60° may cause unit not to spin and generate an error (dc)
 - See bulletin for software change on Main PCB - WF209ANW/XAA, WF218ANB/XAA, WF218ANW/XAA, WF219ANB/XAA, WF219ANW/XAA
- Installation issues – Not leveled, Not locking the lock nuts, Bending legs or frame when lifting, Shipping bolts in place, Springs or struts broken or loose.
- Installed on slippery floor without rubber foot pads.
- Not properly locked on pedestal.

Questions or comments? Please e-mail richard@marcone.com

Vibration/Balance Issues

Use on slippery floors for stability. There is one in each package, so order 4 of them

New models have Plastic on the front and rubber on the back, and should not slip.



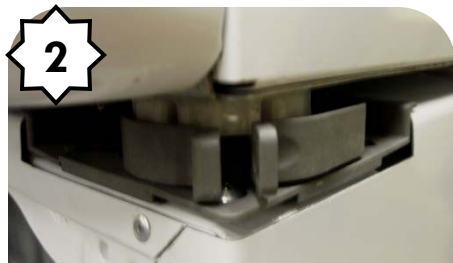
When installing a washer and dryer on the first, or second floor this is not recommended.



When installing a washer and dryer on the first, or second floor this is recommended.

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PEDESTAL INSTALLATION



Plastic Leg
on the Front

Leg doesn't
lock in clamp

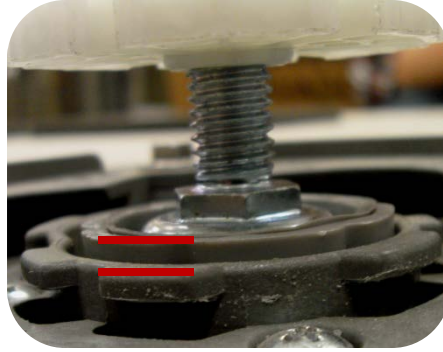
Turn Leg $\frac{1}{4}$
turn CW

Leg will now
Lock

The washers now come from the factory with two different type leveling legs. The washer is usually shipped from the factory with the plastic type leveling legs on the front and the rubber type mounted on the rear.

PEDESTAL INSTALLATION

When the plastic leveling legs are mounted on the rear, the leg does not sit as deep in the clamp as when mounted in the front. This is causing the bottom of the clamp to hit the top of the leg and prevents the clamp from closing. In order to fix this situation you need to remove the plastic legs from the rear and remount them on the front of the washer.



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Washer foot damage

This will cause the washer to “walk” during spin cycles and may cause a no spin condition.

Floor Model sale. Washer slid across warehouse concrete floor

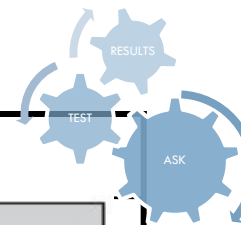
Washer sliding/walking on consumer's concrete floor over time.

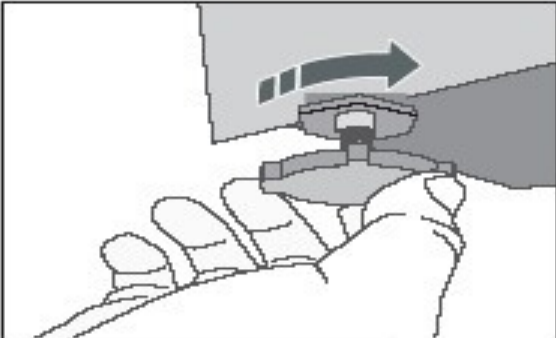
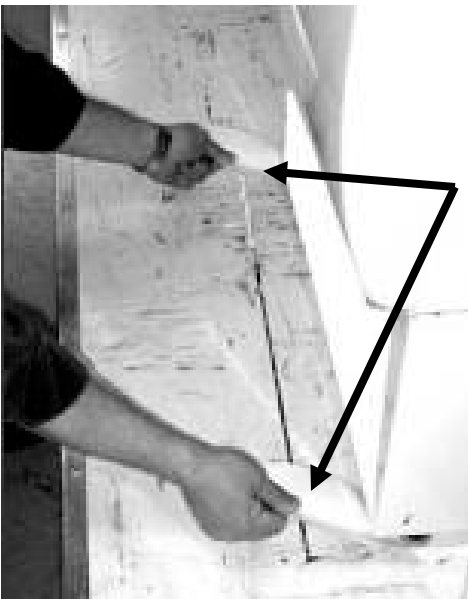


Questions or comments? Please e-mail richard.kuemin@marcone.com



Washer Vibration Testing



No	Description	Image
1	Tighten the lock-nut up against the base frame.	
2	<p>Put a couple of articles of clothing inside and place paper strips under each leg. And then, put the unit into Spin Mode as follows.</p> <ol style="list-style-type: none">1. Power ON press SIGNAL and EXTRA RINSE for 3 seconds2. Press the Delay Start and Silver Care Keys for 3 seconds to enter Quick Spin Test Mode. <p>As its speed increases, try to pull out the paper stripes.</p> <p>Notice! If you find foot-print on the paper, or the paper is slipped out, lower the regarding leg slightly and tighten up its lock-nut against the bottom plate. And, repeat the test until there is no slip-out or foot-print.</p> <p>Notice! Partial circle footprint on paper could indicate a bent leg or frame.</p>	 <p>Paper</p>

Questions or comments? Please e-mail richard.kuemin@marcone.com



Over Sudsing

ALWAYS USE HE Detergents

- When using the “recommended” amount of detergent in soft water with “clean” clothes, it is possible to get Oversudsing.
- Unless clothing is “dirty”, in soft water use 1/2 or less of the recommended detergent.
- Bedding/Towels retain detergent most

Over Sudsing, Drawer Leak

Consumers wash “clean” clothes in soft water, no “soil” for the detergent to hold in suspension, creating over sudsing.

Questions or comments? Please e-mail richard.kuemin@marcone.com

Over Sudsing, Drawer Leak



Over Sudsing, Drawer Leak

Small puddle under the drawer usually means over sudsing



LEAKAGE FROM THE FRONT DOOR



Even when using the recommended “HE” detergent, if too much detergent is used suds will be created.

LEAKAGE FROM THE FRONT DOOR



Suds have gathered between the door and the front panel.

Hair or threads will also cause “wicking”, clean the boot area.

LEAKAGE FROM THE FRONT DOOR

Once the suds start to dissipate it will leak from the front door area.

A small puddle under the door usually means over sudsing or water being “wicked” out.



Over Sudsing

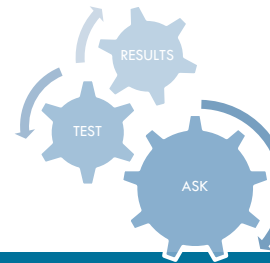


Questions or comments? Please e-mail richard.kuemin@marcone.com



Washer Troubleshooting

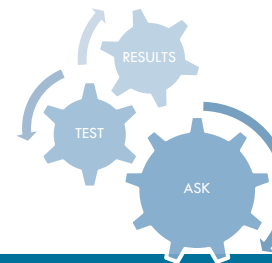
What's done when tech arrives at home?




- ✓ Talk to the Consumer, don't trust the work order
- ✓ The Diagnostic Mode is the most valuable troubleshooting tool you have for troubleshooting a Washer. When you are at the product this **MUST** be the first test you should do.
- ✓ Removing power will not erase Fault Codes.
- ✓ When some models are put into the “**Quick Test Mode**” all fault codes will be erased.



Samsung 'Washer' Diagnostic Code Quick Guide

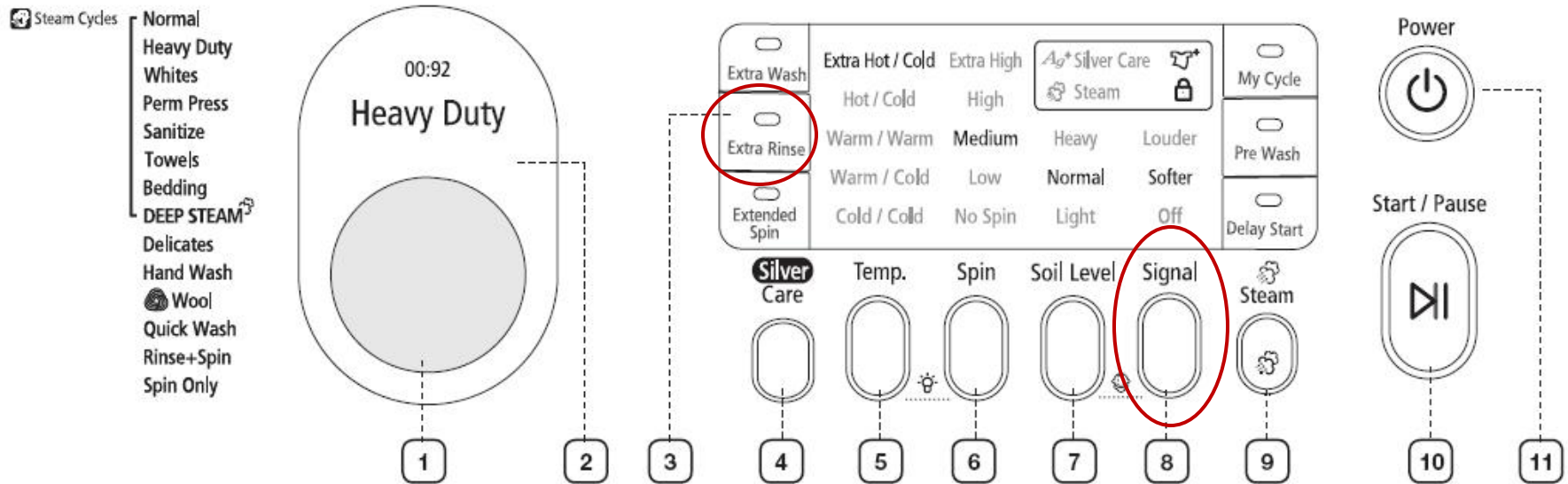
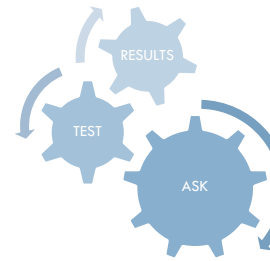


No	LED Display	Code	Description	Corrective Action
1	nd	1	The water level fails to drop below the Reset Water Level within 15 minutes.	Check for Foreign material in pump or hoses. Verify the wiring harness is connected properly. Check the water pump terminal. Check for freezing
3	nF	3	When the water fill continues for more than 16 minutes or there is no change of water level for 3 minutes	Check the water valve wiring harness. Check the water supply valve for clogging with foreign material and whether water is supplied properly. Check for reversed fill hoses. Check water temperature, if sensed as higher than 50 °C in the Wool or Lingerie cycle it will create error. Check the relays, if they operate correctly replace the Main PCB.
5	nF1	5	The Hot/Cold water connection is not correct	Correct Hot/Cold hose connections
6	LeE or LE	8	Water Level Sensor Trouble. (When the input signal from the water level sensor is out of range, the unit will send out beeping sounds and halt the cycle.)	Check the Hose where the sensor is connected, may be loose, pinched, damaged or clogged. Also check the sensor it may be disconnected or defective. The Main PCB may also be defective
7	OE	E	A fault is detected in the water level sensor. Data (frequency) shows the water level is at or above the overflow water level. Drain process may also occur.	Water is supplied continually because the water level detection does not work. - Verify the drain is working properly. Verify the water valves shut off fully. Finally check the water level sensor.
8	dc	10	Unbalance or cabinet bump is detected during final spin, which prevents the drum from spinning over 400 rpm. (Never exceeds 400 RPM due to unbalanced load)	Check type of laundry. Check whether it may cause an unbalanced situation.- Educate the consumer to press pause, reposition the load or remove a few items. Check bulletin on WF218
9	-	11	EEPROM Fault. (Program settings are being reset.)	Go to "EEPROM Clear Mode" If display shows "FAiL", Replace Machine Control Board
10	E2	15	Jammed/Stuck Key. (When key input signals are detected for more than 30 seconds, it is a stuck key.)	Check all of keys. If A key is sensed to be pressed, all keys will not respond
11	dL dS LO FL	18 22 2 4	Door is detected as open when the motor is operating. Door is detected as open while trying to lock the door. Door fails to unlock after 3 attempts. Door fails to lock after 3 attempts.	Check the door switch and latch alignment. Check the latch for damage. Check the wiring harness to the latch. Check the door switch. Replace if faulty. Finally verify the operation of the Main PCB
14		29	Abnormal high/low temperature or resistance (Thermal sensor or PBA) resistance.	Check loose or pinched wires. Check thermistor if OK Replace PCB.
16	Sr	34	System Relay (Main Relay) Failure. (PCB does not notice the relay operation when there should be.)	Replace PCB.
17	Hr	36	Heater Relay Failure (No Heater Relay Check Signal)	Check for short or a wire disconnected to the heater circuit. Check for tub contacting the heater or if the water in the tub is frozen or there is no water. The error is triggered by temperatures above 145C. If the heater is OK, replace PCB. An Hr error occurs if the steam heater is faulty, replace it.
18	3E 2E E3 bE	3E 91 92 25	Motor Drive Error or Hall Sensor error	Check the motor drive & Hall sensor connector. Check for foreign object inside the motor/stator or motor/stator damage. The drum may be overloaded with clothes or the relay or PCB may be defective.
21	8E	8E	MEMS Sensor Failure. (No MEMS Sensor Check Signal)	Check MEMS PCB ,Main PCB & Wire-harness
22	7E	7E	Silver Care Kit (Silver Care PCB) Failure.	Check Silver Care PCB ,Main PCB & Wire-harness
23	PF	-	It occurs when there is power failure during the washing.	("PF" is not an error. It is to inform of power failure.)
24	SuDS or Sd	-	Suds is detected during the washing session. ("SudS" may light up instead of remaining time.)	"SudS" is not an error. Guide a user to reduce amount of detergent usage.
25	9E1		EMC Filter issue or a noise spike from an external device	
26	AE		Communication Error between Main PCB and Sub PCB or PBA	Check Main PCB & Sub PCB Wiring harness. If OK replace PCB
27	SF1, SF2, SF3		System error	Replace PCB Replace PCB Replace PCB

Questions or comments? Please e-mail techsupport@marcne.com

Test Mode & Error Check

Service Mode



Definition of Service Mode:

- Service Mode enables service technicians to verify the operation of the washing machine and do troubleshooting.
- Service Mode can be entered during all washing cycle without interrupting the cycle except some of test modes.
- Various tests can be done with Service Mode. So, troubleshooting can be done based on the resulting diagnostic codes.

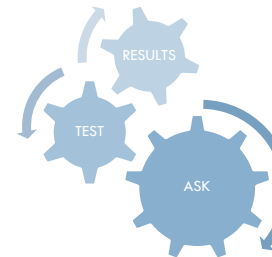
How to Enter:

- To enter the Service Mode, press the **Signal** and **Extra Rinse** Keys for 3 seconds or until the unit sends out beeping sounds.

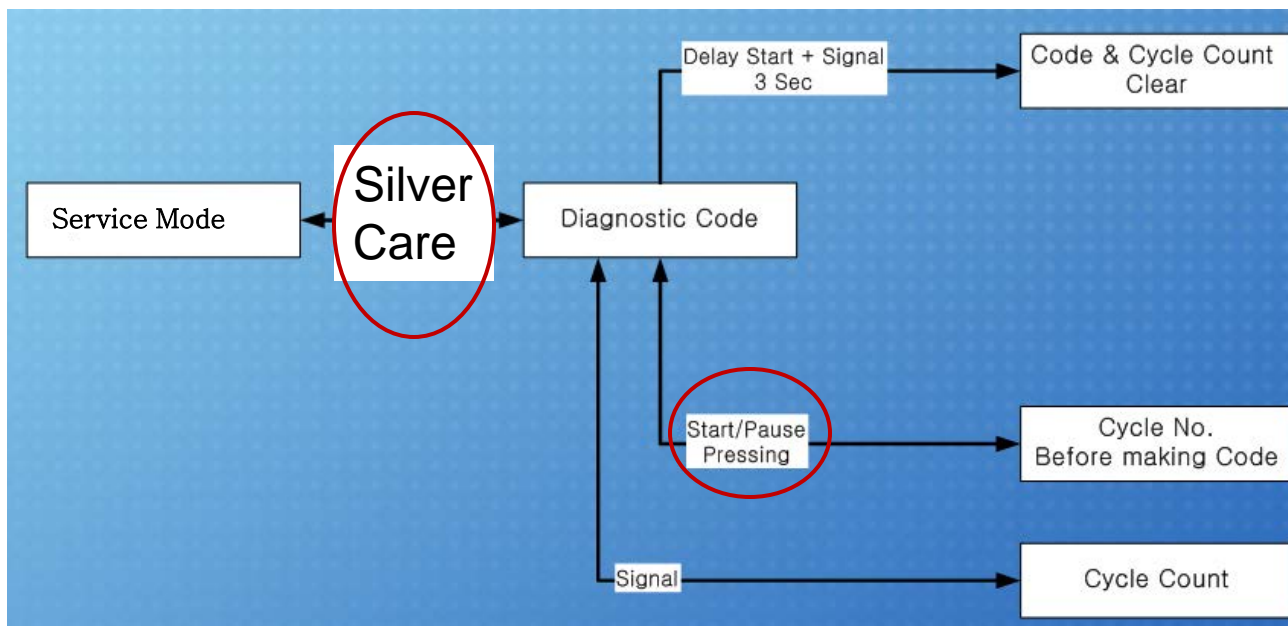
Questions or comments? Please e-mail richard.kuemin@marcone.com



Error Check



Diagnostic Code Check Mode



Definition of Diagnostic Code Check Mode:

- Diagnostic Code Check Mode is to bring up the stored diagnostic codes (reference codes for service technicians).

How to Enter:

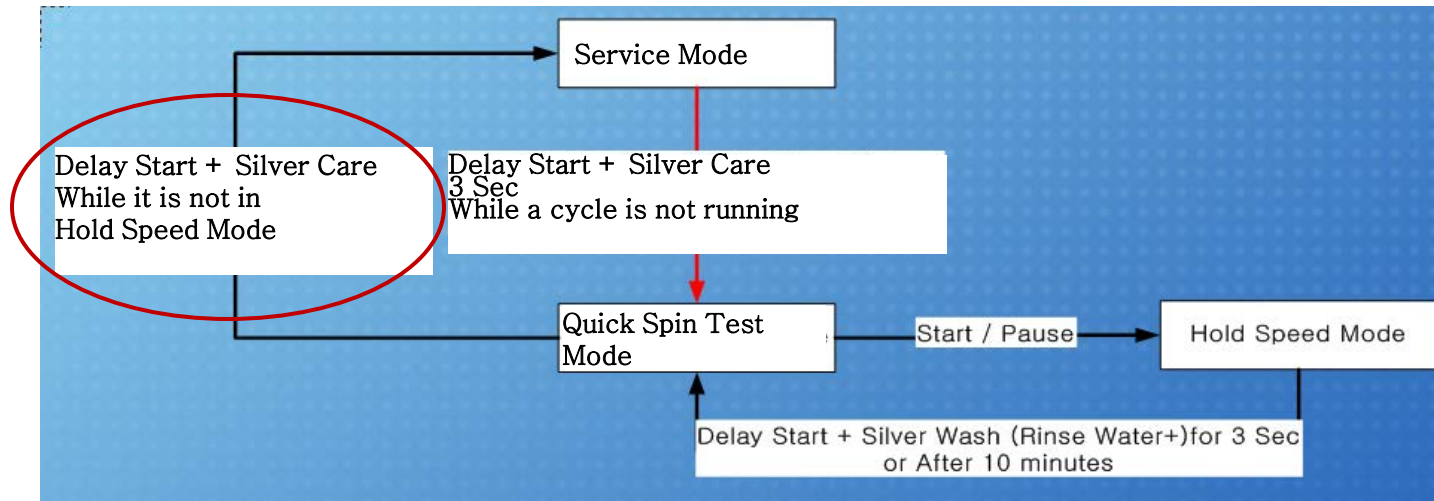
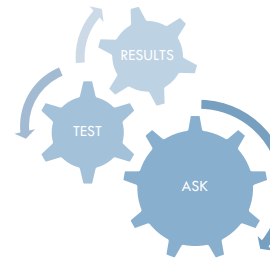
- To enter the Diagnostic Code Check Mode with code "d" flashing, press the Silver Care (Rinse Water +) during Service Mode.

Questions or comments? Please e-mail richard.kuemin@marcone.com

Test Mode

Quick Spin Test Mode

Note: Stay with the washer during this test (out of balance detection may be bypassed and door may not lock).



Definition of Quick Spin Test Mode:

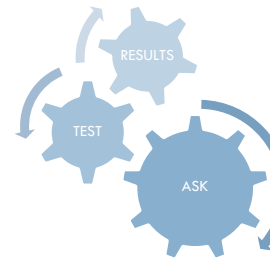
- Quick Spin Test Mode is to do Spin Check. (High RPM)

How to Enter:

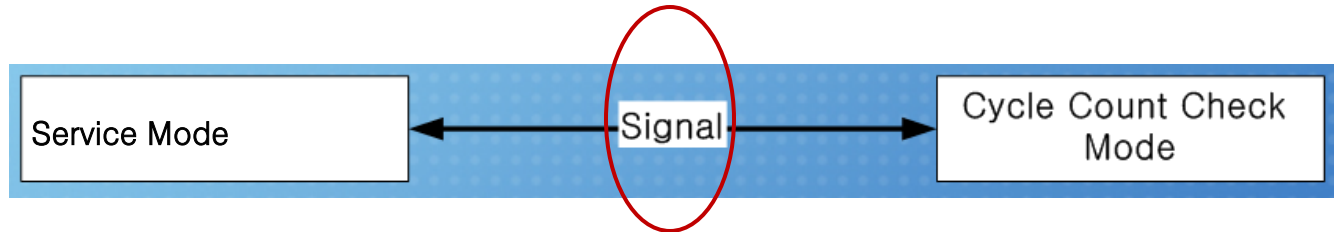
- During Service Mode, press the Delay Start and Silver Care Keys for 3 seconds to enter Quick Spin Test Mode.
- **Cannot enter once the washing cycle has started.**

Questions or comments? Please e-mail richard.kuemin@marcone.com

Test Mode



Cycle Count Check Mode



Definition of Cycle Count Check Mode:

- Cycle Count Check Mode is to tally up the number of washings.

How to Enter:

- To enter the Cycle Count Check Mode, press the Signal Key during Service Mode.

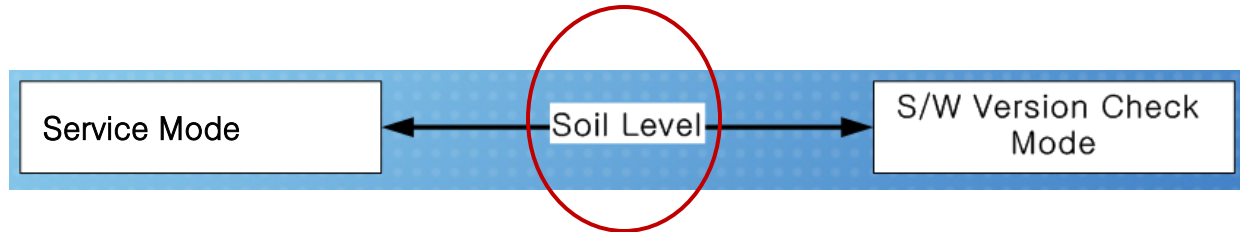
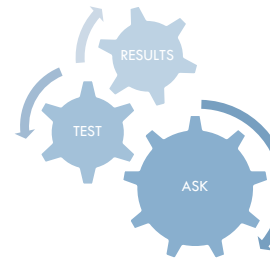
Cycle Count Check Mode:

1. Activate the Service Mode in advance.
2. When the Signal key is pressed, the total number of washings will light up and a signal LED will glow (Louder, Softer, Off LED).
3. The maximum number of cycles will be 9999.
The counter will roll over to 0 and start counting again after 9999.
4. The counting will be carried out at the end of the normal cycle.
5. To exit the Cycle Count Check Mode, press the “Signal” key again.

Questions or comments? Please e-mail richard.kuemin@marcone.com

Test Mode

S/W Version Check Mode



Definition of S/W Version Check Mode:

- S/W Version Check Mode is to bring up S/W Version information.

How to Enter:

- To enter the S/W Version Check Mode, press the Soil Level Key during Service Mode.
(same for all Frontier models.)

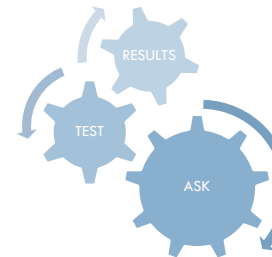
S/W Version Check Mode:

1. Activate the Service Mode in advance.
2. Press the Soil Level Key to bring up its software Version
Ex) Generate F020 for version 20.(F0 is micom code, 20 is it's software version)
3. To exit the S/W Version Check Mode, press the Soil Level S/W once again.
Then, it returns to the Service Mode with motor RPM illuminating.

Questions or comments? Please e-mail richard.kuemin@marcone.com



Test Mode



Board Input Test Mode



Definition of Board Input Test Mode:

- Board Input Test Mode is to display a specified input after a key press.

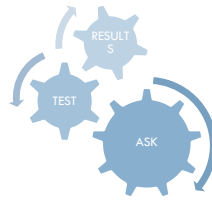
How to Enter:

- To enter the Board Input Test Mode, press the Extra Wash key during Service Mode. (same for all Frontier2 models.)

NOTE: #7 can be done during fill, to verify frequency change

Board Input Test Mode:

1. Activate the Service Mode first.
2. Press the Extra Wash key to start Board Input Test.
3. Turn the Jog-Dial so that the Extra Wash LED is turned on, and Press the Start/Pause Key. The **Water Temperature** will be displayed in Celsius.
4. Turn the Jog-Dial so that the Extra Rinse LED is turned on, and Press the Start/Pause Key. The **Water Temperature** will be displayed in Fahrenheit.
5. Turn the Jog-Dial so that the Extra Spin LED is turned on, and Press the Start/Pause Key. The **door status** will be displayed (OP if open, CL if closed).
6. Turn the Jog-Dial so that the Delay Start LED is turned on, and Press the Start/Pause Key. The **door lock Switch** status will be displayed (UL if unlocked, Lo if locked).
7. Turn the Jog-Dial so that the Pre Wash LED is turned on, and Press the Start/Pause Key. The **Water Frequency** will be displayed.
8. Turn the Jog-Dial so that My Cycle LED is turned on, and Press the Start/Pause Key. The **AG Kit** status will be displayed in 3 seconds. ("E" if the AG kit is abnormal. "—" if the AG Kit is working properly)



Samsung Washer Test Modes Special Test Mode (SERVICE MODE)

Power ON press **SIGNAL and EXTRA RINSE** for 3 seconds

Quick Spin Test = Delay Start & Spin - WF203, 206, 218, 209

Quick Spin Test = Delay Start & Silver Care - WF306, WF316, WF317, WF326, WF328, WF337, WF448

Note: Stay with the washer during this test (out of balance detection bypassed and door may not lock).

Quick Spin Test = Delay Start & Steam - WF338

(Hold at desired RPM during this test with Start/Pause)

Note: Stay with the washer during this test (out of balance detection bypassed and door may not lock).

Cycle Count = Signal - All Models

Soft Ware # = Soil - All Models

Fast Time Down = Temp - All Models

Fault Code Test = Spin - WF203, WF206, WF218 (Turn Selector Knob CW)

Fault Code Test = SilverCare - WF306, 316, 317, 326, 328, 337, 448 (Turn Selector Knob CW)

Fault Code Test = Steam - WF338 (Turn Selector Knob CW)

Push Start/Pause to view # cycles back failure occurred

Board Input = Extra Wash – All Models (Turn Selector Knob CCW)

Questions or comments? Please e-mail richard.kuemin@marcone.com

1 Temp Celsius Selector to “Heavy Duty” press Start/Pause.

NOTE: Not all Board Input tests on all models
Service Mode subject to change without notice.

CONT. Board Input = Extra Wash – All Models (Turn Selector Knob CCW)

5 Overflow Water Level Selector to “Delicate/Hand Wash” press the Start/Pause dial: “_0” if below level, “_1” if above level.

The above water level is defined as the overflow water level.

6 Heater-On Water Level Display Selector to “Wool” and press the Start/Pause dial: “_0” will illuminate if below level, “_1” if above level (Heater-On).

The Medium water level is defined as the level needed for the heater to turn on.

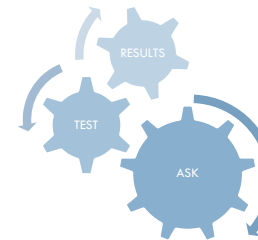
7. Reset Water Level Display Selector to “Quick Wash” and press the Start/Pause dial: “_0” will illuminate if below level (Reset), “_1” if above level.

8 Water Level Display (Frequency) Selector to “Quick Wash” press the Start/Pause dial: If it illuminates “2435”, it indicates 24.35 kHz.

9 AG Kit Status Selector to “Sanitize” press the Start/Pause dial, it will display the Ag Kit Status in 3 seconds: “_ -” if AG kit is operated properly. “7E” if AG kit is out of order (check wire harness & PCB)

10 MEMS Sensor Kit Status. Selector to “Spin Only” press the

Start/Pause dial. Then, it will display the MEMS Sensor Kit status



Sometimes access to the Quick Test Mode may change during production.

Effective 4/1/2009 a software change was made. After the displaying the software version, turn the Jog dial CCW to display “F4” for test modes

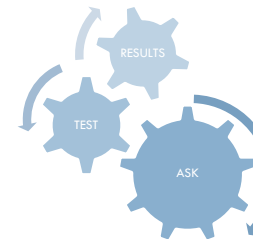
A software change was made during production on the WF209 & WF219.
After the displaying the software version,
turn the Jog dial CCW to display “F4” or
“00” for test mode

Use: ***Soil, Signal, & Power*** on some production dates

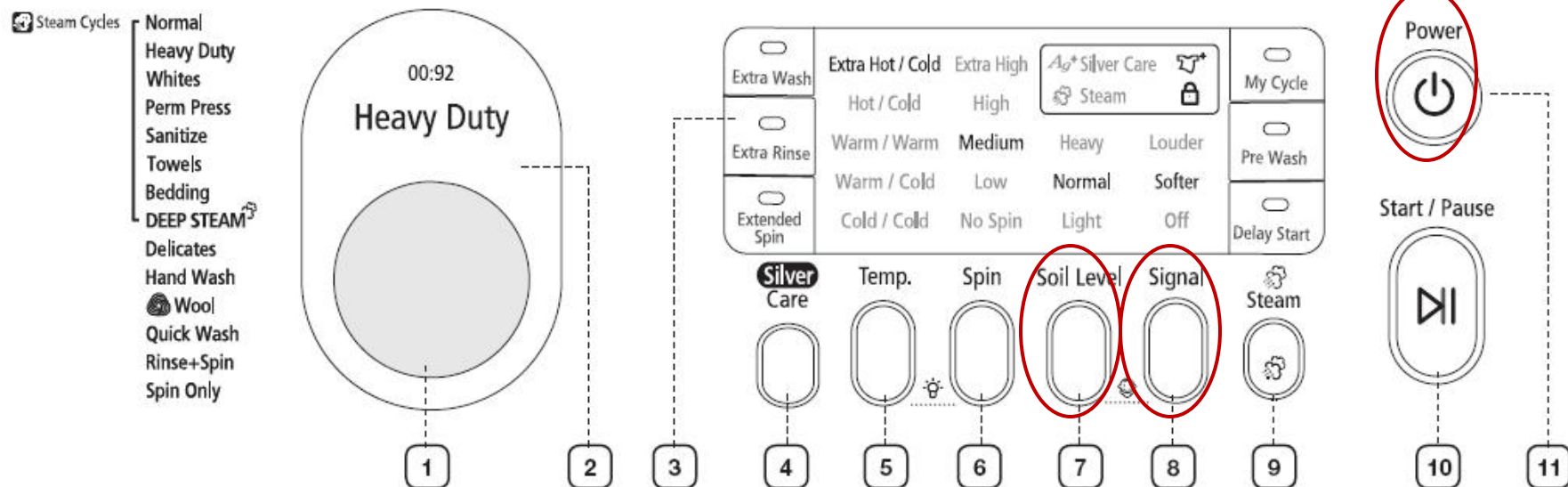
Pwr Off press Soil Key, Signal Key and Power Key at the same time. When the version is displayed, turn the Jog-Dial so that the version disappears.



Test Mode



Quick Test Mode



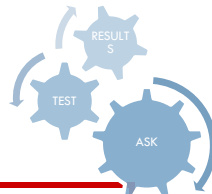
Definition of Quick Test Mode:

- Check operation of all LED's (Verify faulty LED).
- Check model and software version.
- Check different operating modes (e.g. water valve, motor, door, drain pump, etc.).

How to Enter:

- Plug in and turn on the unit.
- Press Soil Key, Signal Key and Power Key at the same time.
(Same for all Frontier2 models.)

Questions or comments? Please e-mail richard.kuemin@marcone.com



Using wrong Keys for Quick Test Mode

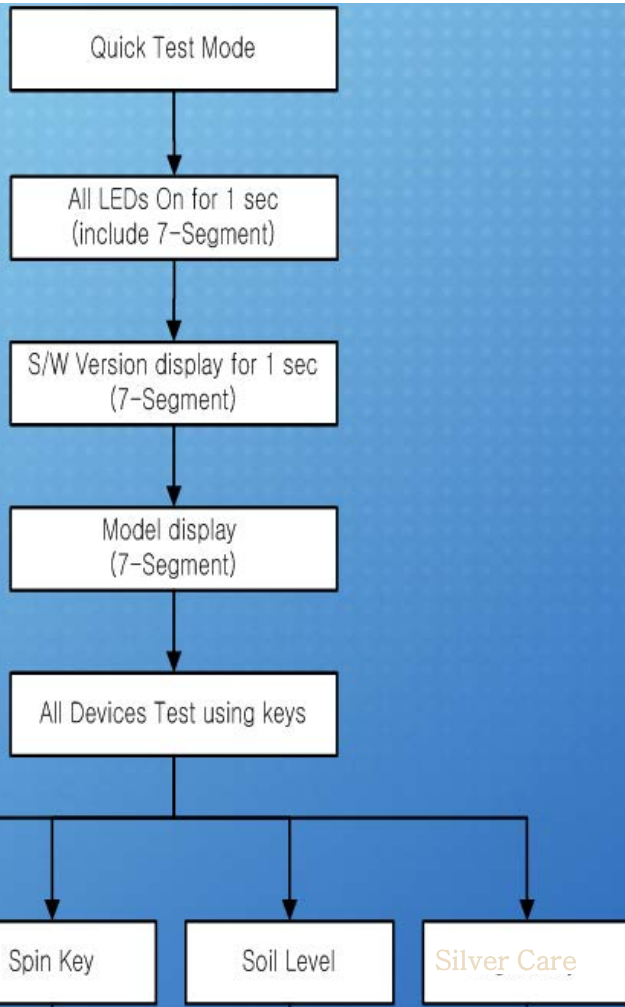
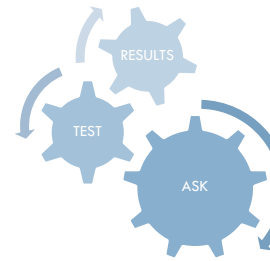
If you select the wrong test mode keys, in this case **Spin + Soil Level + Power**, the test mode will not be activated. But with the WF448 if you select this combination of keys the unit will display the software version briefly, than a “te” error code.
(As seen in figure #2)

This mistake will happen when trying to activate the Quick Test Mode. If you select the **Spin + Soil Level + Power** keys on the WF448 the unit will display the error code illustrated below. There is nothing wrong with the Thermistor, or Main PCB.



Test Mode

Quick Test Mode



Quick Test Mode:

1. All LED's light up and it sends out Beep Sound when it enters into the Quick Test Mode.
2. Displays software version for a sec. and Clear EEprom.
(Ex. If S/W Version is 23, LCD will display F223)
3. After displaying the software version, LCD will display the following information for each model.
 - F1 : WF337AAW, WF337AAG, WF337AAL, WF337AAR
 - EEEE : Model option Error (Need to replace PCB Ass'y.)
4. When the version is displayed, turn the Jog-Dial so that the version disappears. Press the following keys to test the various components
 - Temp Key : Water Valve Test
 - Spin Key : Door Lock/Unlock Test
 - Soil Level Key : Circulation/Drain Pump Test.
 - Signal Key : Water/Steam Heater Test

When either Test or Spin is displayed on the LCD, press the Start/Pause key to conduct the motor test.

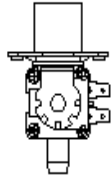
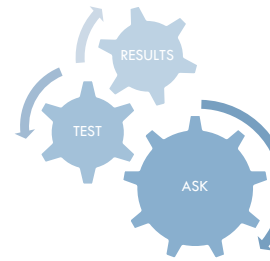
In Test mode, you can test the clockwise and counterclockwise movement of the motor.

However, the water level must satisfy the heater water level (24300) to enter Test mode.

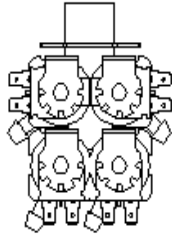
In Spin mode, you can test the motor at a high rpm.

Questions or comments? Please e-mail richard.kuemin@marcone.com

Water Flow Chart



Path #1



Path #2

V#1

V#2

V#3

V#4

V#5

Path #5

MAIN(H) PRE WASH BLEACH MAIN(C) STEAM

Path #4

Path #3

It is normal for some water to remain in Detergent Drawer after it completes washing. Bleach is usually flushed out into the tub at the beginning of the washing. Also, its compartment is washed again during the following rinse cycle, removing any remnants.

V#3 & V#4 both on for Softener dispensing, two streams hit and go down middle channel
Water Pressure is Critical

Some Models, softener dispense can be checked in the Quick Test Mode, for others, start in Rinse & Spin Cycle and after fill, within a few minutes, the fabric softener will dispense

Pre Wash

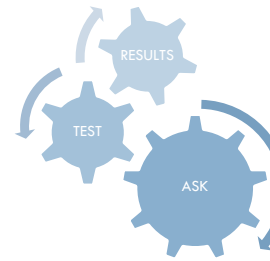
Bleach

Main Wash

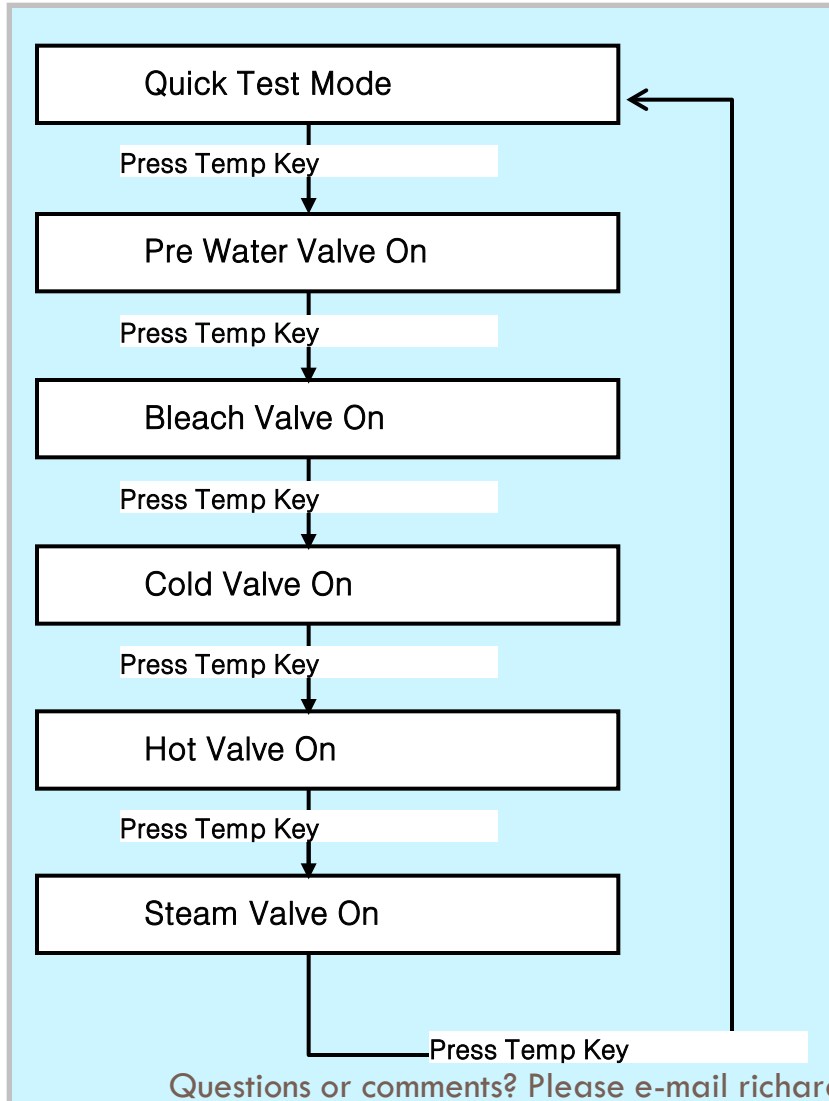
Softener

Questions or comments? Please e-mail richardkoehn@marconet.com

Test Mode



Quick Test Mode



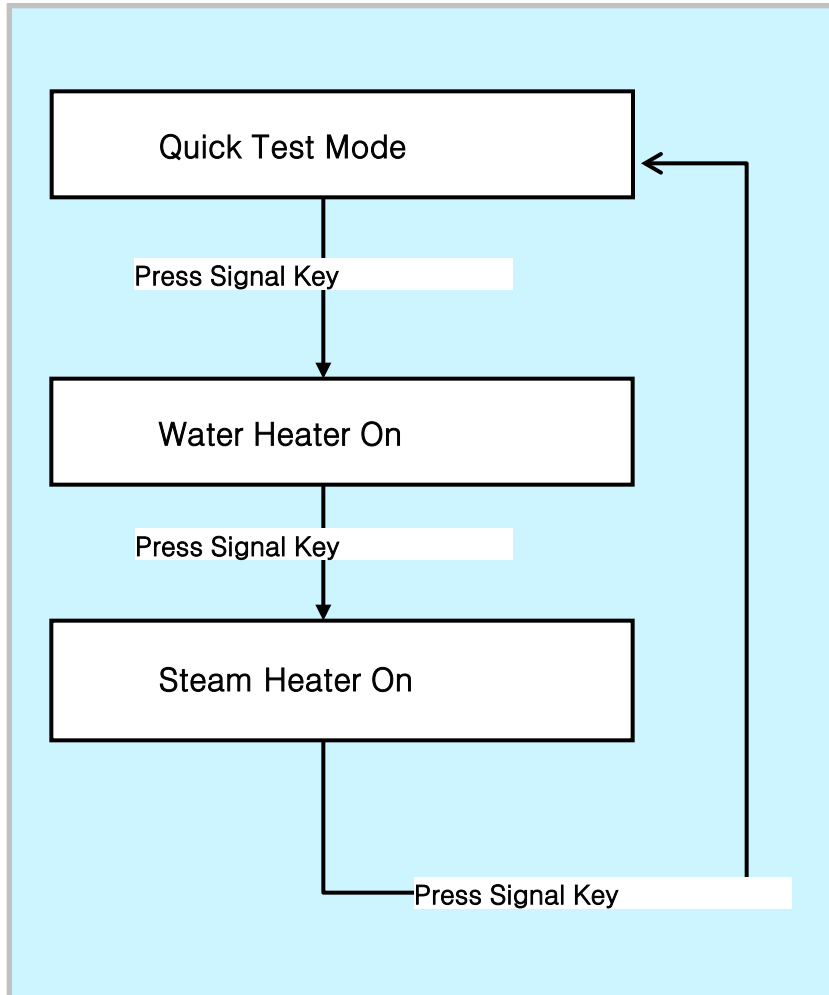
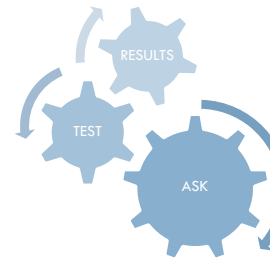
Water Valve Test:

1. To enter the Water Valve Test, press the Temp Key while model information is being displayed during the Quick Test Mode.
2. Each time the Temp Key is pressed, it will cycle through the operations on the left flow chart.
3. If the Temp Key is pressed during All Water Valve OFF, the machine will return to the beginning as shown in the flow chart.
4. The door needs to be secured for the Water Valve to operate. Therefore, the door lock will be on during the water valve operation.
5. If there is any problem with Water Valve, PCB Ass'y. or Wire Harness, the water valves could not operate. So, to make sure for the water valves to operate, check visually if water comes out with each Water Valve On mode.

Questions or comments? Please e-mail richard.kuemin@marcone.com

Test Mode

Quick Test Mode



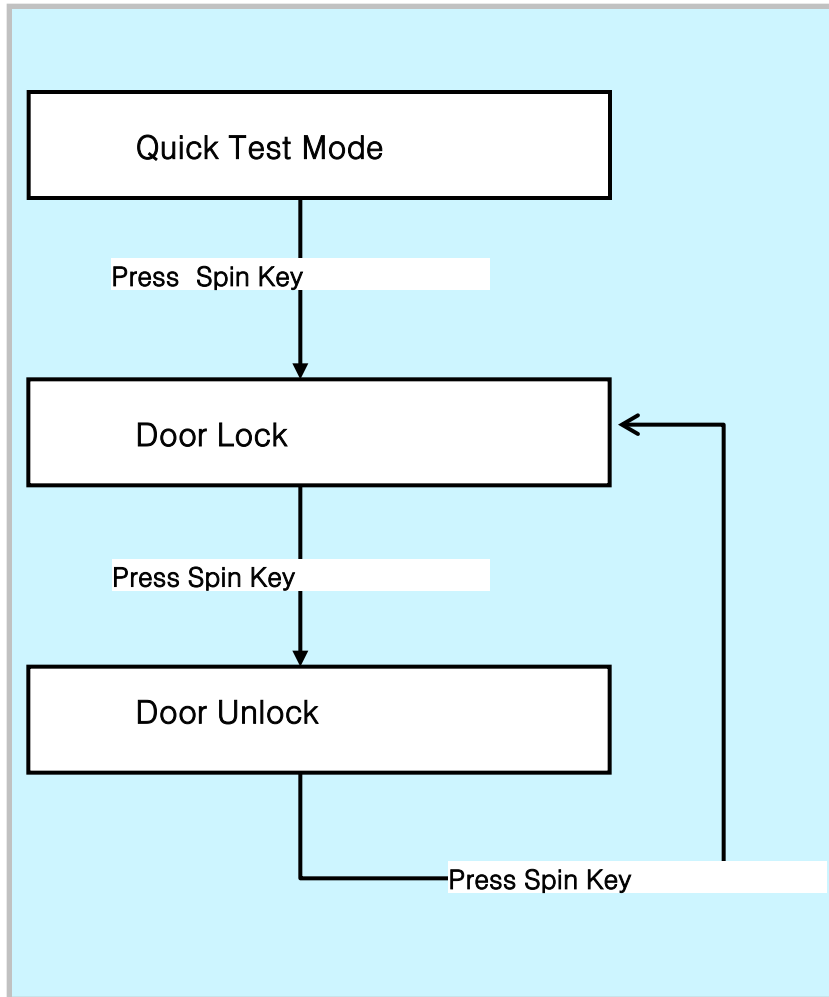
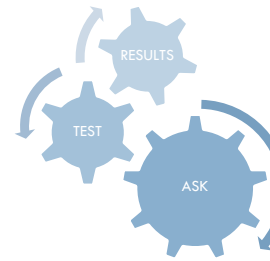
Heater Test:

1. To enter the Heater Test, press the Signal Key while model information is being displayed during the Quick Test Mode.
2. Each time the Spin Key is pressed, it will cycle through the operations on the left flow chart.
3. If there is any problem with Motor, PCB Ass'y. or Wire Harness, related error codes will be displayed.

Questions or comments? Please e-mail richard.kuemin@marcone.com

Test Mode

Quick Test Mode

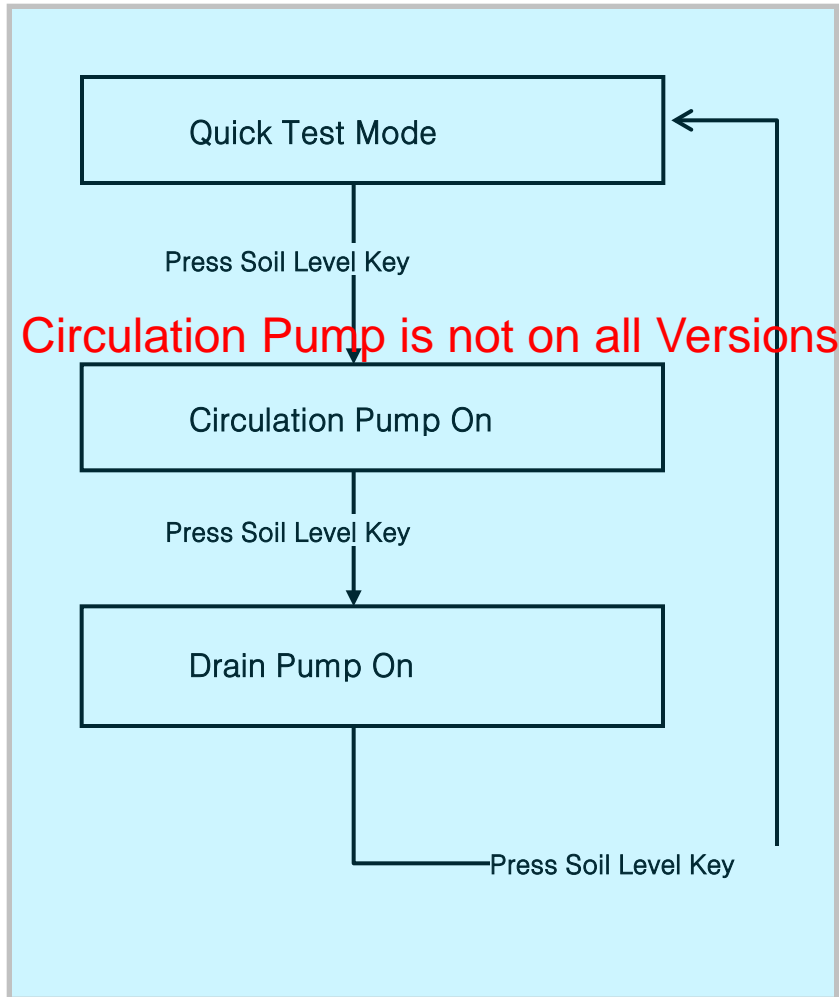


Door Lock/Unlock Test:

1. To check the Door Lock/Unlock operation, press the Spin Key while model information is being displayed during the Quick Test Mode.
2. Each time the Spin Key is pressed, it will cycle through the Door Lock/Unlock operations on the left flow chart.
3. If the Spin Key is pressed during Door Lock and Water Valve, Motor or Drain Pump operation, all of the operations will stop. And, when the Silver Care Key is pressed again, the door will be released.
4. If there is any problem with Door Switch, PCB Ass'y. or Wire Harness, related error codes will be displayed.

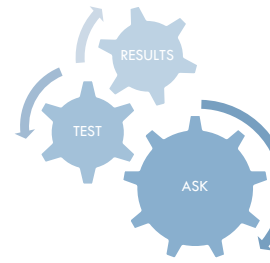
Test Mode

Quick Test Mode

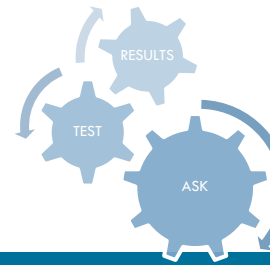


Drain Pump Test:

1. To check the Drain Pump operation, press the Soil Level Key while model information is being displayed during the Quick Test Mode.
2. Each time the Soil Level Key is pressed, it will cycle through the operations on the left flow chart.
3. The Drain Pump operation is independent. Therefore, it will operate regardless of Door Lock/Unlock.
4. If there is any problem with Drain Pump, PCB Ass'y. or Wire Harness, the Drain Pump will not operate. So, its operation needs a visual inspection.



EEPROM Clear Check



This should be done when a new Main PCB is installed

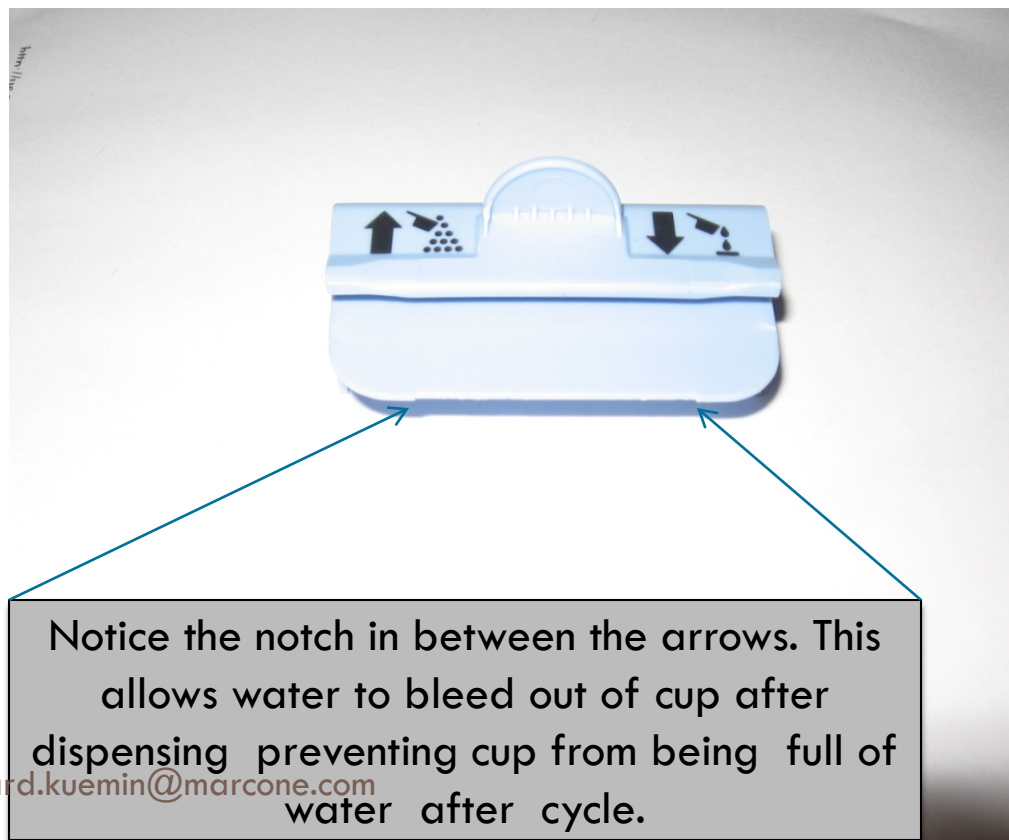
- ☐ Power off, Press Delay Start, Signal and Power Key at the same time.
- ☐ Good = Good Fail = FAiL
- ☐ All memory will be cleared, including Fault Codes

Troubleshooting Tips

- ☐ Liquid detergent seeping from main wash cup into the prewash cycle
- ☐ Leak at Detergent Drawer
- ☐ Pump Noise
- ☐ Intermittent stopping in cycle
- ☐ Siphoning faults
- ☐ Fabric Softener Dispensing
- ☐ Steam Operation
- ☐ Oil/Grease stain on clothing

Questions or comments? Please e-mail richard.kuemin@marcone.com

Liquid detergent seeping from main wash cup into prewash after filling cup is normal and is necessary by design to prevent water standing in cup when cycle is complete. This will not effect normal operation and some of the detergent will enter during prewash, selections without prewash will see no difference. If the customer wants to use the pre wash option recommend using a powder detergent.



Part Change

Before

After

DC67-00420A

DC67-00444A

GUIDE-LIQUID:
DC61-02472A



- Height : 35mm
- MAX Detergent (g):140g
- Siphon Detergent(g):150g

- Height : 26.5 mm
- MAX Detergent (g): 75g
- Siphon Detergent (g):150g

Questions or comments? Please e-mail richard.kuemin@marcani.com

Detergent Drawer Leaks



The hose from the detergent draw housing may be clogged with various items. Bleach or detergent caps may act like butterfly valves and cause intermittent leaking from the drawer



Leaks from the detergent draw due to the inlet and hose to the inner tub being clogged with power detergent due using too much or wrong powder detergent.



Questions or comments? Please e-mail henrik.kuemi@marcone.com



Intermittent Stopping in Cycle

Hot Water Valve May Be Used On “Cold” Fills

Bad hot water valve, faucet off, plugged filter screen could cause a “nF” fault intermittently.

			Temperature Control	
			°C	°F
Wash	Extra Hot	Sanitize	65	150
	Hot	Others	50	120
		Normal	40	105
	Warm		30	85
	Cold		15	60
Rinse	Warm		25	80
	Cold		tap cold	tap cold

Questions or comments? Please e-mail richard.kuemin@marcone.com

Intermittent Stopping in Cycle

- The unit sometimes will pause during **Sanitize, or Pure Cycle**, wash modes and appear not to be functional.
- The Sanitize and Pure Cycle wash cycles have target temperatures to assure washer performance.
- If the water temperature doesn't meet the target temperature during the wash cycle, the washer will automatically add extra time to allow the heater to bring the water up to the programmed, or target temperature.
- In this stage, the displayed time will pause and hold until the heating operation has been completed.
- It is at this point that the customer may feel that operation has stopped. (The maximum added programmed time is 30 minutes)



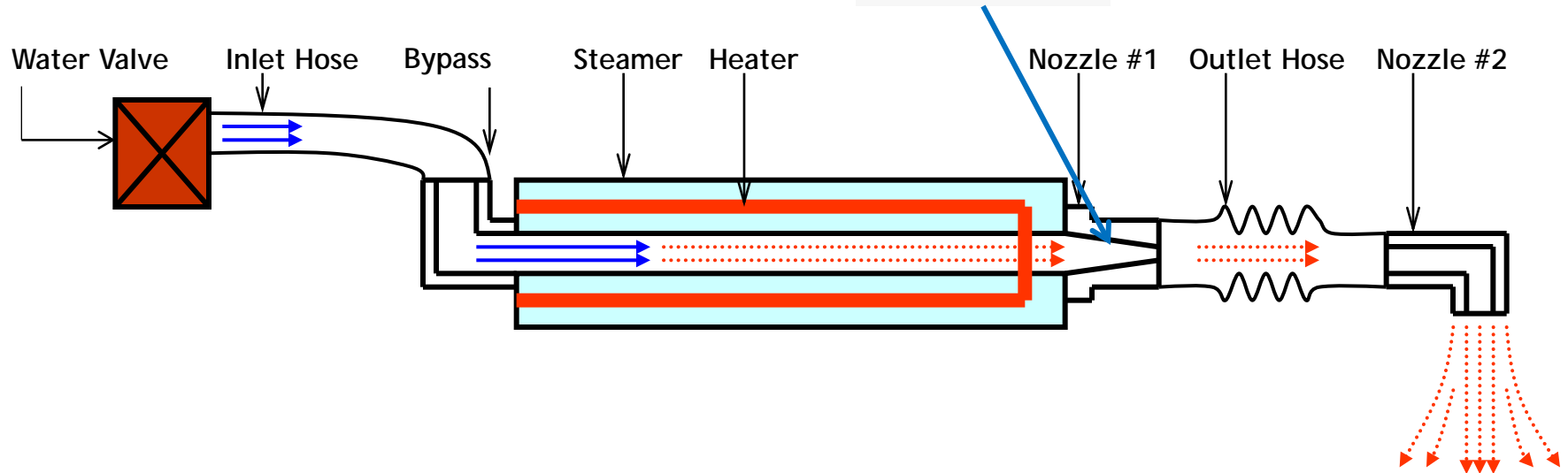
Water Errors

Error on Screen	Code	Cause	Fix
WATER LEAKAGE PROBLEM	01	Water level drops below heater level, over 5 times during wash	Check for leak Check for siphoning at drain SUDSING?
LOW WATER PRESSURE	03	Not reaching "fill" condition within 15 minutes. Fill starts, then no change detected within 2 minutes	Check water supply and fill valves. Check for siphoning at drain
WATER LEVEL SENSOR PROBLEM	08	Water level detected below Empty or above Overfill for 10 seconds	Defective Level Sensor or connecting wires
WATER SUPPLY PROBLEM	E, 01	Level over the overflow pressure sensing for over 15 seconds	Valve stuck open

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WF448 Steamer Operation

◆ Steamer Structure and Control



[Ass'y-Steamer]

- Heater : 1350W
- Duct temp. : 180~200°C
- Duct material : Aluminum
- vapor pres. : 0~0.6 kgf/cm²
- Bypass pres. : 2.0±0.5 kgf/cm²
- Steam temp. : 100~120°C
- Temp-control : Thermostat
- Safety : Thermostat --- 1EA
Thermal Fuse - 2EA

[Water Valve]

- Pressure : 0.5 ~ 10 kgf/cm²
- Flow rate : 300 ml/min
- "2s on/9s off" Time Control

[Steam]

- Temperature : 90~100 °C (Nozzle)
- Jet velocity : 11~12m/sec
- Making Cycle : 7~9sec Making
and 2~4sec pause

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STAINED CLOTHES



This could happen on a new product.

Consumer was getting stains on white clothes. They said the stains resembled oil stains. Found petroleum jell like substance in the debris filter. This substance is similar to the lubricant that is on the diaphragm. Clear grease will combine with the dirt in the water and leave dark “oily” stains.

WF448 Connector Checks - **Use Only Fast Tracks** by model number

Water Temperature Thermistor Check	Test 1	Test 2
Connector CN 7 Pin 4 (Yellow) and CN7 Pin 5 (Orange) USE SERVICE MODE, MUCH FASTER	Operating voltage at Room temperature	Operating Resistance at Room Temperature. Disconnect CN7(Power off)
	4.2VDC (5VDC May indicate a connector issue)	50-57kΩ
Door Switch Check	Test 1	Test 2
Connector CN4 Pin 1 (Pink) and CN4 Pin 3 (Gray) USE SERVICE MODE, MUCH FASTER	25VDC Door Open, 0VDC Door Closed	Operating Resistance with power off
		24kΩ
Water Level Sensor Check	Test 1	Test 2
Voltage: Connector CN 7 Pin 6 (Pink) and CN7 Pin 5 (Orange) And Connector CN 7 Pin 7 (Violet) and CN7 Pin 5 (Orange) Resistance: Connector CN 7 Pin 6 (Pink) and CN7 Pin 7 (Violet) USE SERVICE MODE, MUCH FASTER	Operating voltage at no water in the drum-	Operating Resistance (Power off)
	2.5VDC	Pin 6 (Pink) and Pin 7 (Violet) 22- 24Ω
Hall Sensor Check	Test 1	Test 2
Connector CN6 Pin 4 (Orange) and Pin 2 (Red) additionally Pin 4 (Orange) and Pin 3 (blue)	Manually spin the drum to see the voltage change, Power On	N/A
	0Vdc or 3.75Vdc	
Motor Check	Test 1	Test 2
Connector CN5 Pin 1 (Blue), Pin 2 (White) and Pin 3 (Red)	Power Off 11.5Ω across Pins 1-2, Pins 1-3, & Pins 2-3	N/A
A/C Power Check	Test 1	Test 2
Connector CN 2 Pins 1 (Black) and 2 (Yellow)	Power On 120VAC	N/A

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WF448 Connector Checks **Use Only Fast Tracks** by model number

Mini Manual with Washer has errors, Service and Training Manuals have errors

Door Lock Check	Test 1	Test 2
Connector CN2 Pin 3 (Gray) and CN3 Pin 1 (Black)	When Door is Locked or Unlocked there is a pulse of 120VAC for a few milliseconds.	With Power Off, the resistance between these pins will be between 47 - 57Ω
Door Unlock Check	Test 1	Test 2
Connector CN 2 Pin 3 (Gray) and CN3 Pin 2 (White)	When Door is Locked or Unlocked there is a pulse of 120VAC for a few milliseconds.	With Power Off, the resistance between these pins will be between 47 - 57Ω
Drain Motor Check	Test 1	Test 2
Connector CN2 Pin 3 (Gray) and CN3 Pin 3 (Violet)	120VAC with the pump On and 0VAC with the pump off	Power Off, the resistance should be 13.9Ω
Water Valve Check	Test 1	Test 2
Connector CN2 Pin 3 (Gray) to CN3 Pin 5 (Pink), Pin 4 (Brown) , Pin 7 (Yellow), Pin 8 (Blue), Pin 9 (Red)	120VAC with the Valve On and 0VAC with the Valve off	Power Off, valve resistance is from 1202Ω - 1245Ω
Heater Relay Check	Test 1	Test 2
Connector CN2 Pin 3 (Gray) and RY3 (heater relay) Pin 2 (Red)	120VAC with the Heater On and 0VAC with the Heater off	Power Off, heater resistance is 16.6 Ω
Steam Heater Relay Check	Test 1	Test 2
Connector CN2 Pin 3 (Gray) and RY4 (heater relay) Pin 1 (White)	120VAC with the Heater On and 0VAC with the Heater off	Power Off, heater resistance is 15.6 Ω

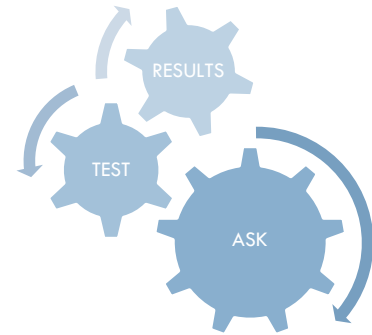
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MANUALLY RELEASING THE DOOR LOCK (WF210 – WF220)

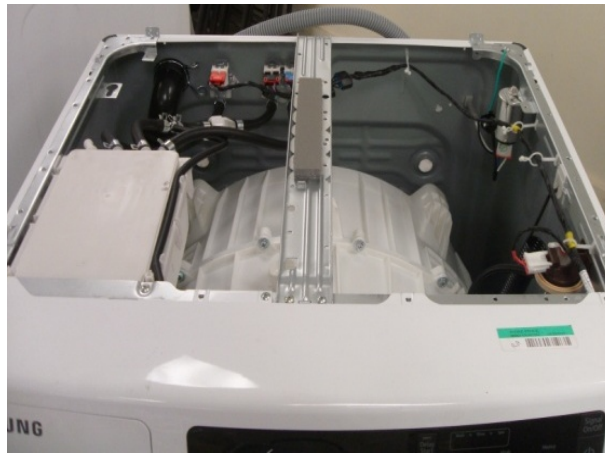
In some cases the door lock will be activated and can not be deactivate. Even if the machine is shut down, or unplugged, the door will still remain locked. In this situation the door lock can be released manually. The following procedure is to release the door lock manually.



Indicates the door is locked.



Step #1



Remove the two screws from the rear of the top panel and remove the panel.

Step #2



Remove the four screws from the control. You then can either disconnect the control panel, or carefully place it on top of the unit.

Step #3



Remove the four screws from the front panel.

Questions or comments? Please e-mail richard.kuemin@marcone.com

Step #4



Once the four screws have been removed from the front panel, place a screw driver on the small metal tabs on each side and push down. As you push down, pull the panel forward to release it from the tabs.

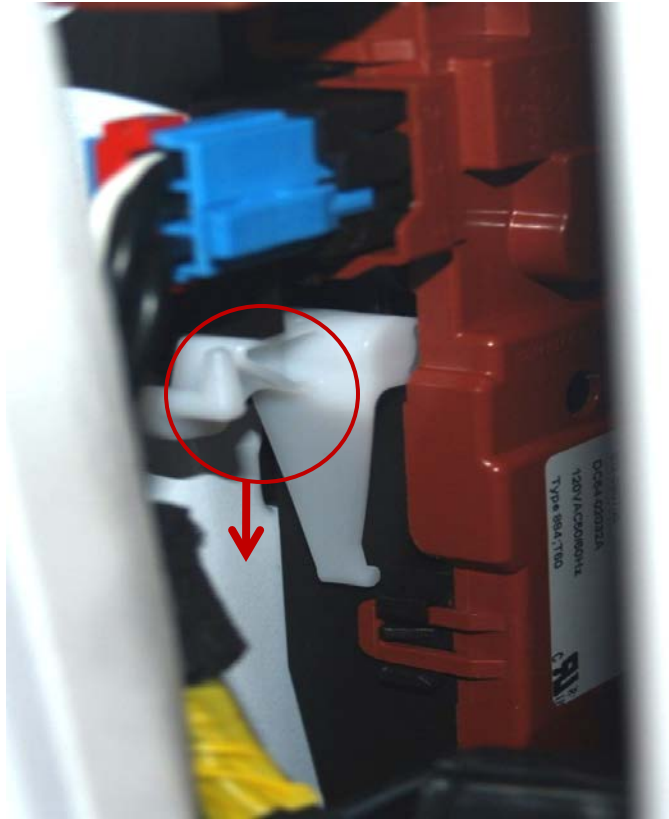
Step #5



Once the front panel has been released from the two metal tabs, carefully lean it forward. At this point the door switch should be exposed. You now can pop the plastic cover off.

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Step #6



After removing the plastic cover push down on the white knob. This should release the door lock and you will be able to open the door. It is very important to replace the cover.

Models WF210/220



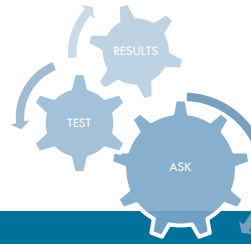
ALL other WF Models



With both types of door locks, you have to manually release them gently. If you apply too much force, the manual release mechanism will break. Once this mechanism breaks, the door lock may or may not work on the WF210/220 but will still work on other models. But you will no longer be able to release the door manually, unless you replace the “door lock ass’y”.

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UNLOCK WASHER

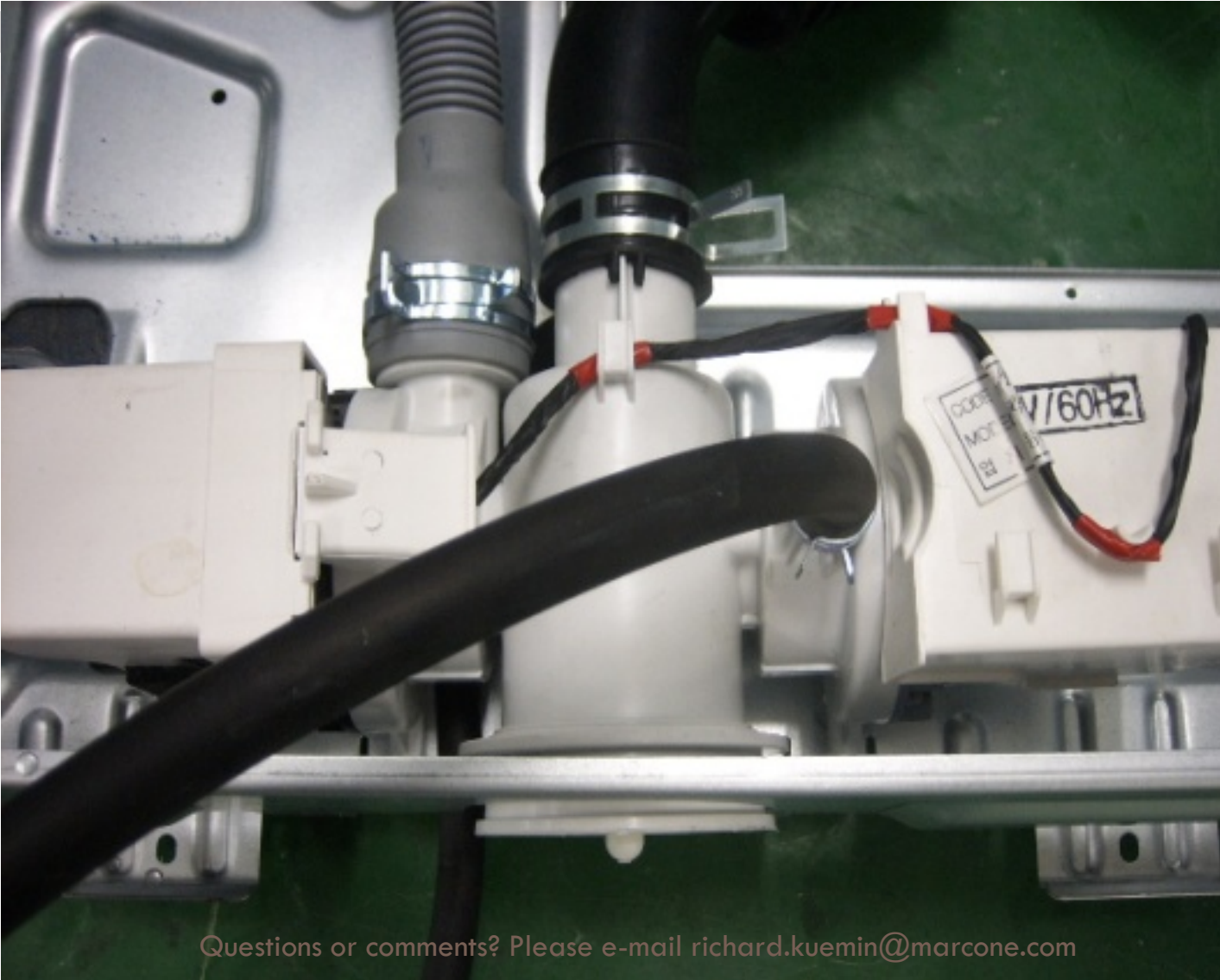


- How do we unlock the WF448?

- If the power fails while the door is locked, the door will remain locked until the power comes back on. If the power comes back on while the door is still locked, the cycle will resume where it left off. If the door is unlocked, “PF” will display and the washer will pause. Press Power Off and restart the cycle.

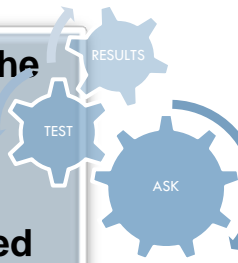
Pump Replacement

Recirculation Pump removed in later versions



Recirculation Pump is our new “Bubble” creating device.

Questions or comments? Please e-mail richard.kuemin@marcone.com



- 1) Place the Assy-Pump Drain into the unit.
- 2) Insert the pump cushion into the opening at the base of the unit.
- 3) Once the pump cushion is inserted into the opening slide the assembly forward to lock.
- 4) After the Assy-Pump is locked in place secure the pump bracket to the base of the unit.

Pump - Cushion

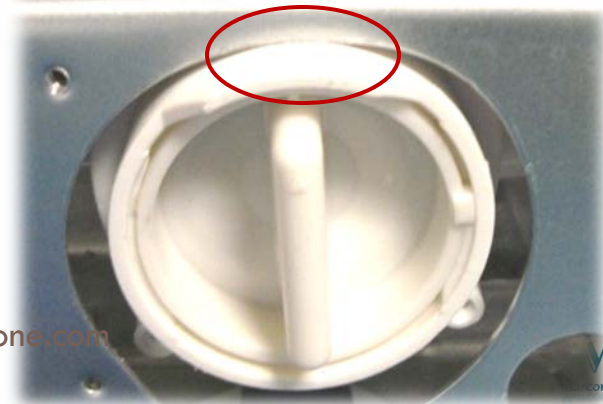
View from under the unit

If the Assy-Pump is installed without placing the pump cushion into the opening at the base of the unit. The filter assembly will hit against the metal bracket at the front of the unit, causing the pump assembly to make noise.

CORRECT INSTALL



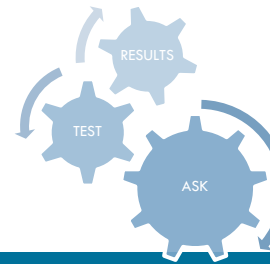
INCORRECT INSTALL



Pump Noise Issue

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Boot Replacement



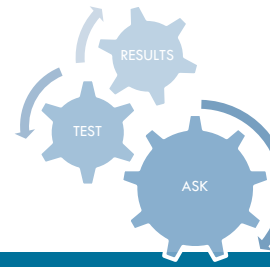
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DANGER Motor Rotor can hurt you, keep fingers on the outside of the rotor

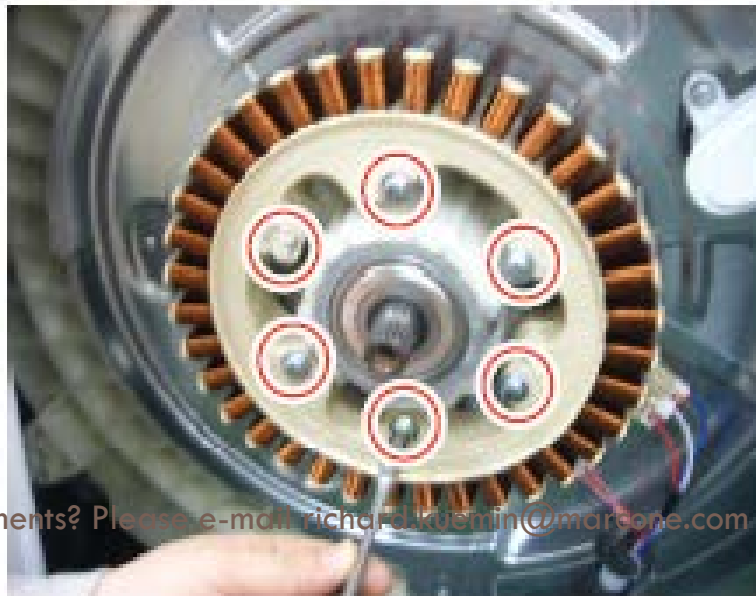


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Motor Replacement



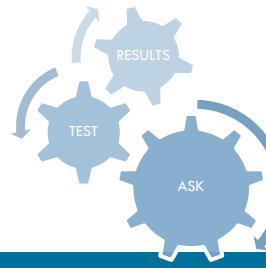
**Hole to lock
Rotor for
removal, don't
use your hand
like shown**



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Spin Basket Replacement



Remove motor and all weights from the outer tub and put a wood spacer under the tub to hold it up higher, to make this a one man job.

Questions or comments? Please e-mail richard.kuemin@marcone.com

The End

Thank You

Questions or comments? Please e-mail richard.kuemin@marcone.com